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HARVARD UNIVERSITY
ARNOLD ARBORETUM
PRESENTED BY
CHARLES SPRAGUE SARGENT
1892

Missouri Botanical Garden Bulletin

Vol. I JANUARY, 1913 No. 1

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29304

BOARD OF TRUSTEES
OF THE MISSOURI BOTANICAL GARDEN

THE ORIGINAL MEMBERS WERE DESIGNATED IN MR. SHAW'S WILL, AND THE BOARD SO CONSTITUTED, EXCLUSIVE OF THE *EX-OFFICIO* MEMBERS, IS SELF-PERPETUATING.

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EDWARDS WHITAKER.

Vice-President,
DAVID S. H. SMITH.

EDWARD C. ELIOT.

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Bishop of the Diocese of Missouri.

A. D. CUNNINGHAM, Secretary.

Missouri Botanical Garden Bulletin

VOLUME I

WITH 28 PLATES AND 4 FIGURES

1913

ST. LOUIS, MISSOURI

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Missouri Botanical Garden Bulletin

Vol. I St. Louis, Mo., January, 1913 No. 1

Foreword

THE Missouri Botanical Garden Bulletin will, until further notice, be issued monthly throughout the year. It is designed solely as a means of communication between the Garden and the public, and will be devoted almost exclusively to informing the people of St. Louis and vicinity what can be seen and learned at the Missouri Botanical Garden. With the completion of the new range of greenhouses there will be announcements concerning special floral or economic exhibits each month, and it is believed that the laboratories, library and herbarium will, from time to time, furnish items of interest. The Bulletin is in no sense a scientific publication, and will not replace the volume hitherto known as the Annual Report, which in the future will be devoted exclusively to the results of scientific research obtained in the laboratories of the Missouri Botanical Garden.

¶ The January number of each volume of the Bulletin will contain the annual

REPORT OF THE OFFICERS OF THE BOARD.

SUBMITTED TO THE TRUSTEES, JANUARY 8, 1913.

To the Board of Trustees of the Missouri Botanical Garden:

We submit for your consideration the financial results for the year ending December 31, 1912.

The earnings from rentals have exceeded those of the year 1911 by $15,423.90, the result of securing tenants for several buildings which were vacant during a portion of 1911-12, though we still have some vacancies, amounting to about $200.00 per month.

As a large portion of our most valuable income property is under lease for long terms, we can hardly expect any further increase in rentals for several years.

During the past year we were compelled to purchase a piece of ground on Grand Avenue, adjoining some of our most valuable residence property on Flora Boulevard, thereby preventing the erection of an automobile gasoline station, at a cost of $8,385.40.

Our expenditure for street improvements has been very small, as some of the improvements mentioned in our last report were postponed until this year, but we will be compelled to pay for the following during the year 1913:

Shaw Avenue	Roadway	$13,500 00
Shaw Avenue	Sidewalk	1,300 00
McRee Avenue	Sidewalk	1,650 00
Arsenal Street	Sidewalk	950 00
City Block No. 4940	Alley	1,257 00
Washington Avenue	Roadway	436 00
St Charles Street	Roadway	545 00
Total		$19,638.00

The tract of land known as Lafayette Avenue Addition, lying west of Grand Avenue, and which is fully improved as far west as Lawrence Street, is being disposed of at satisfactory prices, and already 6,713 front feet have been sold

for about $400,000.00, but there still remain 4,820 front feet, and as soon as a major portion of the remainder is sold we can improve portions of the balance of 20,000 front feet. Nearly all of the lots sold have been built upon, at a total cost of $350,000.

We have disposed of vacant property during the year, as follows:

Lafayette Avenue Addition	1,668 front feet	$149,628 00
Flora Boulevard	357 front feet	25,164 00
Pennsylvania Avenue	150 front feet	750 00

The erection of the new plant house was begun in April, 1912, and will be finished in the early spring, at a total cost of $153,000.00, of which amount $97,436.00 has already been expended.

Other extensive improvements, alterations and repairs have been made at the Garden, requiring a large expenditure, as will be noticed under the head of Garden Improvements, and for particulars you are referred to the Director's Annual Report.

The residence at the Garden, occupied by the Director, has been found to be in a dilapidated condition, and the Board decided to erect a new building, and a contract has been let for a modern residence, to cost about $26,000.00, which is now under construction, and will be finished during the year.

The Library and Herbarium collections have received additions by purchase and gift during the year, valued at the following sums:

Library	$3,195 99
Herbarium	2,120 10

The Annual Bequests, provided for in Mr. Shaw's will, have been carried out only in part. The Annual Flower Sermon and Annual Gardeners' Banquet, but no Flower Show was held or Trustees' Banquet given.

By reason of the heavy expenditure for Garden improvements, all of the income of the Trust for the year 1912 was expended and $94,424.41 of the surplus accumulated for such purposes.

At a meeting of the Board, held February 19, 1912, the following resolution was unanimously adopted:

RESOLVED, In accepting the resignation of Dr. William Trelease, as Director of the Missouri Botanical Garden, the Board of Trustees expresses its high appreciation of the distinguished services rendered by him during the twenty-two years of his Directorship. The relations between the members of the Board and Dr. Trelease have been most cordial and pleasant. The Board earnestly wishes Dr. Trelease prosperity and personal and professional success.

The Board also voted Dr. Trelease a year's salary from May 1, 1912.

Dr. George T. Moore was elected by the Board to fill the vacancy occasioned by the resignation of Dr. William Trelease, and he took charge of the Garden on May 1, 1912.

RECEIPTS.

Rentals	$157,164 97	
Interest and dividends	8,180 52	
Garden Handbook sales	273 75	
Publication sales	13 00	
Garden sales of material	286 98	
Total income receipts		$165,919 22
Sales of real estate under decree	$ 97,787 40	
Bills receivable account of real estate	21,440 57	
Shaw School of Botany rentals	3,900 00	
Insurance from loss by fire	447 80	
Episcopal Orphans' Home, streets	1,516 25	125,092 02
Total receipts		$291,011 24
Cash on hand December 31, 1912		15,113 28
		$306,124 52

DISBURSEMENTS.

Garden Account:			
Labor pay-roll	$ 25,494 53		
Students' pay-roll	1,981 62		
Open Sunday pay-roll	425 10		
Office assistance	1,711 25	$ 29,612 50	
Fuel		3,658 04	
Water		1,146 40	
Repairs and supplies		2,673 97	
Stable and implements		938 08	
Plants and seeds		1,430 83	
Total for care of garden			$ 39,459 82

Herbarium Account:		
Salaries	$ 1,080 00	
Current expense and additions	1,062 43	2,142 43
Library Account:		
Salaries	$ 2,375 00	
Current expense and additions	2,563 48	4,938 48
Garden Office Account:		
Salaries	$ 6,307 50	
Current Expense	950 33	7,257 83
Research and Instruction:		
Salaries	$ 7,682 87	
Current expense and instruments	1,551 35	9,234 22
Total garden maintenance		$ 63,032 78
Garden Improvements:		
New plant house (partial)	$ 97,436 46	
Connecting all buildings with central heating plant	15,838 87	
General improvements and growing house	2,500 00	
New service-road (partial)	392 75	
New plants	2,499 96	
Director's residence repairs	692 54	
Director's new residence	700 00	120,060 58
Total amount expended on garden		$183,093 36
Property Account:		
State, school and city taxes	$ 37,321 18	
Streets, sidewalks, sewers	4,601 00	
Insurance	4,463 70	
Repairs	7,279 21	
Improvements	2,512 00	56,177 09
Publication Account:		
Twenty-second Annual Report	$ 1,973 44	
Twenty-third Annual Report (partial)	682 79	2,656 23
Bequests:		
Annual Flower Sermon	$ 200 00	
Annual Gardeners' Banquet	297 50	497 50
Sundries:		
Office expense	$ 6,556 07	
Legal and professional services	1,537 50	
Commissions	7,959 61	
Repairs to buildings damaged by fire	447 80	
Testimonial to Dr. Wm. Trelease, late director	5,000 00	21,500 98

Investments:		
Real estate, City Block No. 4952	$ 8,385 40	
Bank certificates of deposit	30,000 00	38,385 40
Total disbursements		$305,433 71
Cash balance December 31, 1912		690 81
		$306,124 52

Respectfully submitted,

EDWARDS WHITAKER, President.

Attest:

A. D. CUNNINGHAM, Secretary.

TWENTY-FOURTH ANNUAL REPORT OF THE DIRECTOR.

SUBMITTED TO THE BOARD OF TRUSTEES OF THE MISSOURI BOTANICAL GARDEN, JANUARY 8, 1913.

Gentlemen:

I have the honor to submit herewith the Twenty-fourth Annual Report of the Director, covering the eight months from May 1, 1912, the date of my appointment, to January 1, 1913.

THE GARDEN.

IMPROVEMENTS AND CHANGES.

1. *Heating Plant.* The most important improvement during the year has been the installation of a central heating plant. Replacing fourteen separate fires, it not only saves much in labor and fuel, but likewise provides a constant and sufficient temperature throughout the various greenhouses, a condition which it was impossible to maintain with the old system. It has been found necessary to replace practically all the heating pipes in the old houses, and the plants, particularly the tropical ones, are already showing the effect of the improved conditions. The office and laboratory building, the museum, as well as the residence, are now all connected with the one heating system.

2. *New Range of Greenhouses.* Ground was broken for the new greenhouses early in April, but owing to various delays the entire range is, as yet, far from complete. The north wing was sufficiently advanced to be used for the chrysanthemums during the month of November, and floral

3. *Rose Garden.* A large collection of hardy roses has been installed south of the residence, replacing the old vegetable garden. About 200 different varieties will be grown, including a collection of ramblers, for which a pergola has been erected.

4. *New Plants.* A considerable number of rare plants, including many of economic value as well as some of exceptional beauty, have been purchased to be grown in the new plant houses. The delay in the completion of the new range has made it impossible to display these, as yet. In fact, most of them have had to be stored in a house in Tower Grove Park, kindly loaned for the purpose. Shipments from Java, Ceylon and Australia are now *en route,* and the unusual opportunity of being able to secure large numbers of rare and beautiful plants from the Franceschi collection of Santa Barbara was made the most of. In addition a representative collection of bulbs, which will afford an attractive display in one of the new houses, has been acquired, and new bedding plants and shrubs of varieties too numerous to mention are now being propagated for the out-of-doors exhibit of next summer.

5. *Personally Conducted Trips.* During the summer and until the first of December, the Assistant Botanist, Mr. Thompson, has been at the main gate at three o'clock every Saturday afternoon for the purpose of pointing out the particular exhibits which were most interesting at the time, as well as showing certain plants or collections for which special inquiry was made. The number availing themselves of this opportunity constantly increased, and has resulted in a more intimate acquaintance with the Garden by the casual visitor. In addition, special appointments have been made with Mr. Thompson, from time to time, by various schools, clubs and associations, who desired information on certain subjects, and it seems probable that the usefulness of the Garden along such lines may be considerably increased in the future.

6. *Propagating Houses.* Two new propagating houses have been erected and will afford much needed space in which to raise the various plants desired for bedding, as well as for the special displays to be shown in the new plant houses from time to time.

7. *Herbaceous Tract.* The old experimental grounds in the herbaceous tract have been done away with and the entire area given over to growing a large number of annuals, either of economic importance or of value in the planting

of home grounds. A considerable variety of climbers was also included this year. The old osage orange hedge was blasted out, and the space reclaimed in this way will be added to the herbaceous tract next year.

8. *Pasture.* A start towards reclaiming the pasture has been made. About seven acres were in corn this year, and an additional area has been fertilized with the idea of raising all the feed for the horses on this land. Large amounts of earth have been hauled in along the northwest border of the pasture, and as soon as this can be covered with top-soil a start toward the permanent planting of this part of the Garden will be made.

9. *Stable.* Three of the oldest horses have been disposed of and a good team of mules purchased. Large quantities of manure have been hauled, some months over 100 loads, part of which, during the last few weeks, has been applied to the various beds in the Garden and later will be used on the pasture.

10. *Telephone Exchange.* The installation of a central telephone exchange at the office has greatly facilitated the direction of work in the Garden, as well as affording an additional precaution in the case of fire. The office is now connected with the laboratories, residence, Head Gardener's office, boiler house and main gate. A pay telephone at the gate is much appreciated by visitors.

11. *Plant Labels.* Considerable progress was made during the summer and early fall in correcting the names on the labels of plants in the Garden. Labels are apt to be misplaced, or the original plant dies out and a new one creeps in, thus, unless the collections are carefully checked, a surprising amount of misinformation may be given the visitor. The labels of the greenhouse plants are now being corrected wherever it is found necessary. A new style of label has been adopted and is now on hand ready for installation in the spring.

12. *Bubbling Fountains, Benches and Signs.* Drinking fountains have replaced the old wells, and some twenty-five new seats have been added in the main garden. There have also been provided about eighty signs, indicating the way to, or giving a brief account of, the various collections throughout the Garden.

13. *North Boundary of Garden.* The improvement of

from six to eight feet has been necessary, and along the line of the new service road to the boiler house large quantities of dirt have been used to raise the level of the fruticetum to that of the road.

14. *Trespassing and Pilfering.* Special attention has been paid to suppressing the depredations committed by thoughtless or vicious individuals. In such cases as seemed to warrant it, prosecutions have been successfully carried through, with a noticeable effect in reducing petty, as well as more serious, offenses.

PLANTS CULTIVATED.

Species or varieties to the number of 1,293 were added to the living collections in the course of the year, and 916 were lost or discarded, making a net gain of 377 and bringing the total recorded as now in cultivation to 12,451.

These forms represent 1,875 genera belonging to 217 natural families, a net addition of 55 genera and 14 families. Plant and seed additions for the year are tabulated as follows:

	Plants or Packets	Value
Bought	37,156	$3,571 08
Donated or presented	5,271	512 00
Collected by employes		
In the Garden	3,224	573 72
Elsewhere	509	50 65
	46,160	$4,707 45
Cuttings raised	24,800	1,240 00
Seedlings raised	58,300	2,915 00
	129,259	$6,862 45

Classified as to hardiness and other features of gardening interest the collection now comprises:

Thallophytes (Agaricaceae)		7
Bryophytes		15
Pteridophytes		245
Spermatophytes		
Gymnosperms		
Cycads		38
Conifers		131
Angiosperms		
Trees and shrubs	1,795	
Hardy and annual herbs	3,941	

Tender plants		
Orchids	693	
Other Monocotyledons	1,879	
Dicotyledons	3,707	12,015
		12,451

PLANTS AND SEEDS DISTRIBUTED.

The 1911 exchange seed list contained 1,539 species and varieties. From this list 7,150 packets, valued at $715.00, have been forwarded to various gardens and institutions, and we have received in exchange 5,271 seed packets, valued at $512.05.

Surplus plants have, as usual, been disposed of to schools, hospitals and various charitable institutions to the number of 11,550, valued at $632.00, an increase in such distribution of more than 10,000 plants over last year.

SUNDAY OPENING AND ATTENDANCE.

The opening of the Garden on Sunday afternoon from April to December has been a great success. Under the old arrangement, with the Garden open but two Sundays in the year, the crowds were so great that it was necessary to enforce certain regulations which prevented visitors from getting the full benefit of the various displays and collections. Since the first day of May most of these restrictions have been abolished and I am happy to say that the crowds have been so well behaved that it does not seem probable that the usefulness of the Garden as an educational factor in the community will have to be unduly curtailed by rules designed for its protection. The ability to get to a plant and read its label is much appreciated by the visitor, and we have been remarkably free from depredations of any kind. The public seems to appreciate the freedom given, and to try in every way to assist in protecting the Garden.

The attendance for the first four months of the year 1912 was considerably below the average for the same months in former years; in some cases the number of visitors being one-half or less that of immediately preceding years. In spite of this handicap the total attendance for the year was greater

Sunday visitors, has in almost every instance equaled or exceeded that of the corresponding month in former years.

The following table of visitors to the Garden for the last four years will be useful for a comparison of the effect of Sunday opening:

	1909	1910	1911	1912
January	806	982	889	506
February	1,007	774	1,265	691
March	1,684	4,066	2,764	1,114
April	8,104	6,716	6,054	4,610
May				
Week day	6,919	9,436	7,942	12,534
Sunday	.....	.....	.....	8,606
June				
Week day	10,470	10,041	8,147	10,453
Sunday	*18,379	*17,406	*7,794	14,537
July				
Week day	9,503	8,564	8,342	13,997
Sunday	.....	.....	.....	3,801
August				
Week day	11,208	13,197	12,927	14,155
Sunday	.....	.....	.....	6,595
September				
Week day	9,112	10,041	9,385	7,036
Sunday	*17,572	*2,297	*14,760	6,278
October				
Week day	9,822	6,674	6,845	11,958
Sunday	.....	.....	.....	8,204
November				
Week day	15,738	20,549	3,003	13,339
	Open nights during Chrysanthemum exhibit		No exhibit	
Sunday	.....	.....	.....	12,481
December			Not open nights	
Week day	424	874	1,126	2,177
Totals	120,748	111,617	91,243	153,072

*First Sunday in June and September only open Sundays in former years.

THE GARDEN STAFF.

Changes in the Garden Staff have been chiefly in the reduction in number of both the responsible men in charge of various departments and of the laborers employed. Mr. J. R. Schramm has been made Assistant to the Director, and Mr. Adolph Jaenicke was elevated from the position of Foreman to Head Gardener, there being no Head Gardener. Mr. J. Burkhardt has succeeded the former gatekeeper. Mr. Irish resigned as Superintendent on July first and the position has been abolished.

GARDEN PUPILS.

The course for the garden pupils was completely revised as outlined in detail to the Board in my July report. Mr. Jaenicke, Mr. Thompson and Mr. Ohlweiler are now in charge of the various courses required of these pupils, and the practical work in the Garden is under the immediate supervision of the various Heads of Departments.

All of the scholarships are now filled, they being assigned to the following pupils: Carl Haltenhoff, Peter Pfaender, Earl Reed, Fred Grossart, Carl Giebel, and Louis Culling. Mr. Nestor L. Phillipi has been admitted as a pupil, paying the tuition prescribed by the Board.

RESEARCH AND INSTRUCTION.

Graduate. Professor B. M. Duggar, Ph. D., of Cornell University, has been appointed Physiologist to the Garden, and is in charge of the Graduate Laboratory. Dr. George R. Hill, Ph. D., of Cornell University, holds the position of Research Assistant. Mr. C. H. Thompson has been transferred from the Greenhouse Department to the new position of Assistant Botanist. While Mr. Thompson is in charge of excursions through the Garden and the checking of plant names, a considerable portion of his time is devoted to lines of work properly considered as research, and he is attached to the Research rather than to the Garden Staff.

The following hold Rufus J. Lackland Fellowships: J. S. Cooley, A. R. Davis, W. H. Emig, Margaret DeMeritt, and L. O. Overholts. In addition the following are engaged in research work, most of them candidates for higher degrees: Mary Bryan, Ruth Beattie, C. O. Chambers, George R. Hill, Jr., F. B. Morgan, W. G. Nolte, W. W. Ohlweiler, M. D. Renkenberger, J. R. Schramm, Mildred W. Spargo.

Undergraduate. No changes have been made in the courses offered at the University this year. I have assumed part of the lectures in Botany 1, as well as taking charge of the five weeks' work in Botany offered for the first time in Zoology 1. I continue to give the course in Sanitary Engineering as in former years. Assistant Professor Coulter and Mr. W. W. Ohlweiler as Teaching Fellow have the remaining undergraduate work. The registration in the vari-

Botany 13, 7; Botany 16, 8; Botany 17, 11; Botany 19, 5; Botany 23, 2; Botany 25, 8.

THE LIBRARY.

All of the books, including the Sturtevant pre-Linnean collection, formerly housed in the old museum building, have been transferred to the main library building, where they are more accessible and the fire risk is less. The library has been entirely rearranged and some additional steel stacks added, so that there is now provision for about five years' normal expansion.

There have been 887 volumes, valued at $1,693.75, and 1,408 pamphlets, valued at $266.80, donated to the library. The number of books purchased was 368 and of pamphlets 216, at a total cost of $870.75. 16,469 index cards have been added, 9,314 of which were purchased at a cost of $144.22. 2,188 cards were rewritten. The number of books bound was 1,136, rebound 103, at a cost of $475.05.

There are now received 1,512 serial publications, of which 1,429 are in exchange for Garden publications, an increase of 17 over last year.

Taking the figures from the Twenty-third Annual Report, with the additions made in 1912, the library now contains:

Books	29,683		
Pamphlets	42,099		
	71,782	valued at	$108,657 02
Manuscripts	110	valued at	1,592 00
Total			$110,249 02
Index cards	787,569	valued at	7,875 69
Total valuation			$118,124 71

THE HERBARIUM.

Owing to a contemplated change in the policy of the conduct of the herbarium, no additions by purchase were made during the year other than those ordered previous to May 1. These amounted to 5,569 higher plants and 1,453 thallophytes, valued at $1,053.30. In addition, there have been donated 5,409 specimens of thallophytes. Notable among the collections presented were those of Professor F. A. Wislizenus, rich in desirable duplicates of flowering plants, and the herbarium of fleshy fungi of the late Dr. Noah M

Glatfelter, presented by the Misses Glatfelter. The latter is a particularly desirable addition to our collection, as it contains such a large number of local specimens, carefully determined and accompanied by voluminous notes. There were 332 specimens collected by employes.

The herbarium now contains 553,439 specimens of higher plants and 61,221 thallophytes, the total valuation of which is $113,989.05.

Other material, supplementing the herbarium, comprises:

Wood specimens, etc., to the value of	$280 00
Microscope slides, etc	410 00
	$690 00

ANNUAL BEQUESTS.

The two annual events provided for in Mr. Shaw's will which took place in 1912 are:

The Flower Sermon, preached in Christ Church Cathedral, St. Louis, by Rev. Z. B. T. Phillips, May 19, 1912, and

The Twenty-third Gardeners' Banquet, held at the Washington Hotel on the evening of December 13, 1912, when Mr. Richard Vincent Jr., President of the Society of American Florists, delivered an address on the recent Horticultural Show at London.

Respectfully submitted,

GEORGE T. MOORE,
Director.

STAFF
OF THE MISSOURI BOTANICAL GARDEN

Director,
GEORGE T. MOORE.

Assistant to the Director,
JACOB R. SCHRAMM.

BENJAMIN MIEGE DUGGAR,
Plant Physiologist.

HERMANN VON SCHRENK,
Plant Pathologist, *Honorary.*

JESSE M. GREENMAN,
Curator of the Herbarium.

CHARLES H. THOMPSON,
Assistant Botanist.

GEORGE R. HILL,
Research Assistant.

CORA H. THOMPSON,
Curator of Library.

JAMES GURNEY,
Head Gardener, *Emeritus.*

ADOLPH JAENICKE,
Head Gardener.

Missouri Botanical Garden Bulletin

Vol. I FEBRUARY, 1913 No. 2

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ST. LOUIS, MO.
1913

PUBLISHED MONTHLY BY THE BOARD OF TRUSTEES

BOARD OF TRUSTEES
OF THE MISSOURI BOTANICAL GARDEN

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Bishop of the Diocese of Missouri.

A. D. CUNNINGHAM, SECRETARY.

FRONT ELEVATION, NEW PLANT RANGE.

Missouri Botanical Garden Bulletin

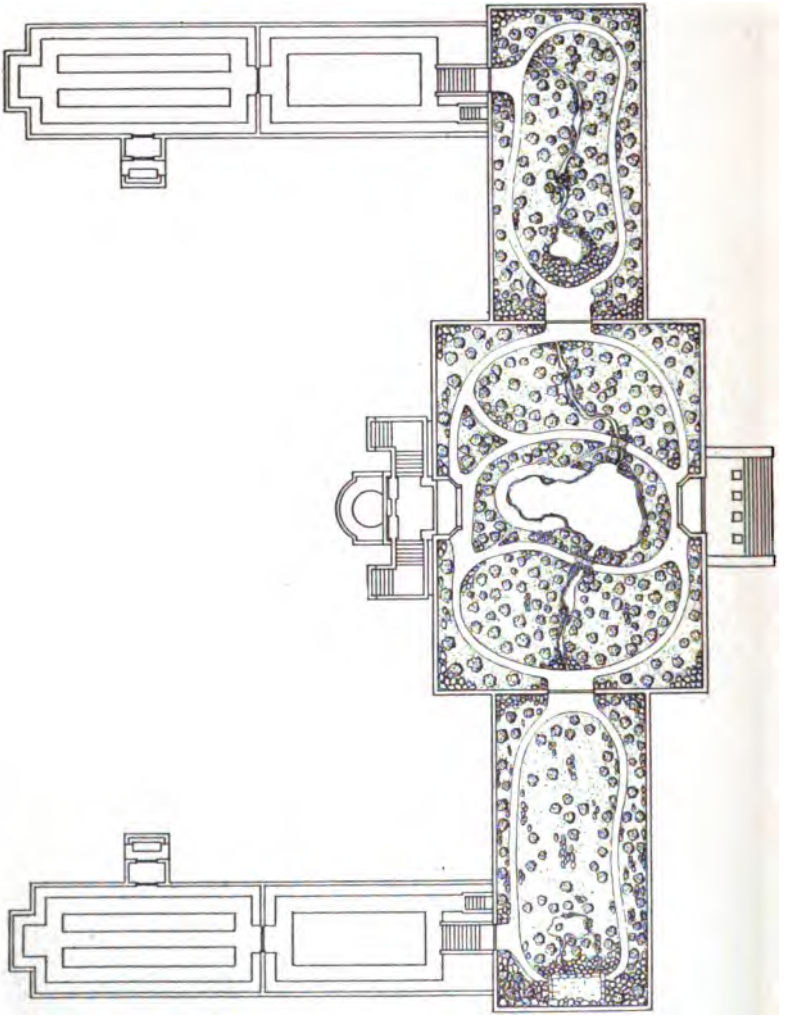
Vol. I St. Louis, Mo., February, 1913 No. 2

THE NEW PLANT RANGE.

The new greenhouses now under construction will, when complete, afford unusual opportunities for growing and exhibiting rare and beautiful plants throughout the year. Particularly in the winter time, when there is little or nothing to be seen outside, the floral displays will provide an attraction which, it is believed, will interest a large number of the public, and make the Garden as desirable a place to visit when snow is on the ground as in mid-summer.

Facing the main gate, behind the old stone wall (soon to be removed), the superstructure now erected gives some idea of the extent and magnitude of the principal range. This is over 300 feet in length and 65 feet in height at the central portion. It will be divided into three parts and instead of the old formal type of greenhouses, provided with benches, the interior will present an appearance which will be unique in this country. The treatment will be that of a landscape, and the planting, for the most part, will be directly in the ground. A small stream, pools and a grotto are included in the scheme, and color will be provided by setting in, from time to time, flowering shrubs and other appropriate blossoming plants. A particular feature of these houses, not usually provided, is the abundant overhead space which will permit large palms, bamboos and tropical vines to be shown to greater advantage.

At either end of the front range, coming off at right angles, are two houses over 100 feet in length which will be devoted more especially to floral displays. In the north house, now open to the public, is at present to be found the exhibition of cyclamen, cinerarias, etc., referred to elsewhere in the BULLETIN. When the entire range is completed it will be possible to look down upon the display in these houses [illegible] one enters from the front range, and that the [illegible]



GROUND PLAN, NEW PLANT RANGE

WEST ELEVATION, NEW PLANT RANGE.

The new central heating plant is an essential adjunct of the greenhouses, and will supply not only the new range, but is now furnishing heat for all the buildings within the Garden.

Extending from the heating plant to the new greenhouses and under the main range is a service tunnel which contains all steam and water pipes and is of sufficient size to permit a hand-cart to pass from one end to the other. By means of manholes all dirt and trash from the greenhouses above can be discharged into a cart in the tunnel, thus avoiding the carrying of such material along the walks of the exhibition houses. The most modern heating and ventilating appliances are being installed, and a 50,000-gallon cistern will furnish all necessary rain-water.

FLORAL DISPLAY DURING FEBRUARY.

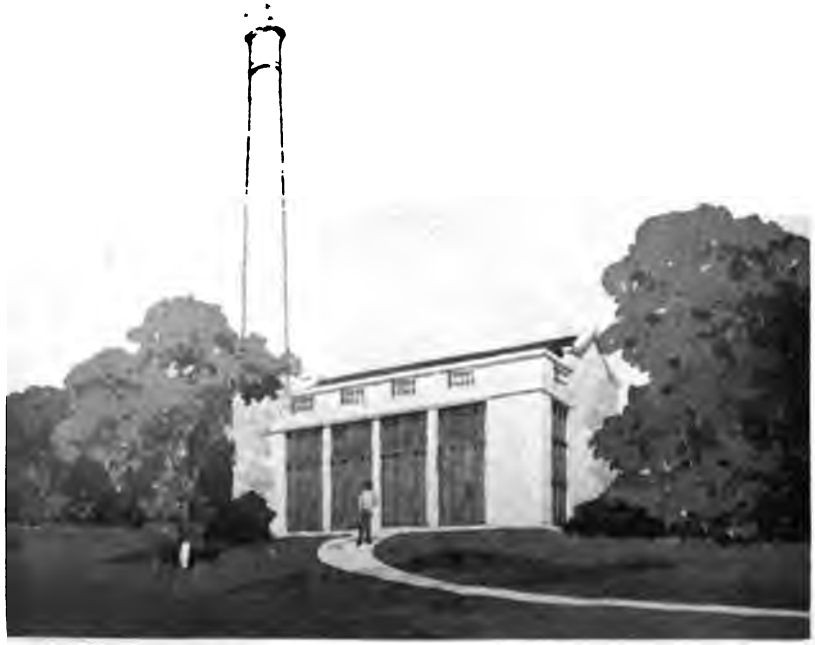
Visitors to the Garden now have access to the floral display in the north wing of the new conservatories, where more than 3,500 flowering plants, in great variety, are on exhibition. This is undoubtedly the largest exhibition of its kind ever held in the city.

Entering the first section of the new houses (temporarily accessible through the north door of the service tunnel), one finds about 900 cinerarias in colors varying from white to blue, pink, red, purple and lavender, with many new and unusual shades. A small group of hardy plants of lilac, hawthorne, crabapple and *Deutzia gracilis,* which have been forced by the use of ether or hot water to bloom at an earlier period, are arranged in the center around a large specimen palm *(Acanthorhiza aculeata)* and have attracted much attention. On the side stages are exhibited the various garden varieties of azaleas *(Rhododendron indicum),* including Simon Mardner, Hexe, Deutsche Perle, Mme. Van der Cruyssen and Mon. J. Peters. Here also are South African bulbous plants *(Veltheimia viridiflora),* with pink tubular flowers on erect spikes; the belladonna lily *(Hippeastrum Johnsoni),* and the Chinese lilies *(Lilium rubrum* and *Lilium album).* The yellow poppy *(Reinwardtia trigyna),* a native of the East Indies, *Senecio Petasitis,* with yellow

In the second section, 1,500 Chinese primroses are the predominating feature, occupying the entire middle stages. The collection includes *Primula obconica,* which is grown very extensively commercially, the color varying from white and pink to faint shades of light blue. The pubescent foliage is, with some persons, poisonous to the skin, producing an effect similar to the poison ivy, only in a milder form. *Primula malachioides,* the baby lavender-flowered primrose, is displayed in quantity for the first time in St. Louis. Its small flowers are arranged in whorls similar to the yellow *Primula kewensis,* but it is much more prolific, as many as half a dozen whorls of flowers being borne on each of the numerous spikes. A good selection of the varieties of *Primula sinensis,* the habit of which is like *P. obconica,* are included in the collection. Exhibited on the side stages are 500 specimens of the alpine violet *(Cyclamen persicum hybridum)* in various shades. These plants were raised from seeds planted in September, 1911. After germination the seedlings form a corm, or bulb, with a small heart-shaped leaf attached. This growth gradually increases throughout the year, finally producing flowers. The west end of the greenhouse is occupied by the hybrid begonias, *Begonia Cincinnati,* with its masses of rose-pink flowers, *Begonia Erfordii,* with white, pink and red flowers; calla lilies *(Richardia africana),* and the leadwort *(Plumbago rosea superba),* with tall spikes of scarlet flowers.

Exotic Houses. The transfer of the flowering plants to the new conservatories has partially relieved the crowded condition of the plants in the old houses, thus allowing part of the masses of economic plants to be segregated into their respective groups. Entering the old range at house No. 12, the collection of guavas are readily seen, including the lemon guava *(Psidium Guajava),* Brazil guava *(Psidium Araca),* mountain guava *(Psidium montanum),* pear guava *(Psidium pyriferum),* Chinese guava *(Psidium chinensis).*

House 11 includes the tropical fruits and condiments. Some of the interesting plants to be found here are the alligator pear *(Persia gratissima),* mango *(Mangifera indica),* loquat *(Eriobotrya japonica),* Mexican apple *(Casimiroa edulis),* sapodilla plum *(Achras Sapota),* date plum *(Diospyrus montana),* marmalade plum *(Lucuma mamosa),* desert lemon *(Atalantia trimera)* and Tasmania currant *(Coprosma Baueri).* The condiments include the cocoa *(Theobroma Cacao),* coffee *(Coffea arabica),* the largest specimen now bearing large red coffee beans, Bengal coffee



CENTRAL HEATING PLANT.

(Coffea bengalensis), Madagascar coffee *(Coffea madagascariensis)*, tamarind *(Tamarindus indica)*, wild clove *(Pimenta acris)*, Paraguay tea *(Ilex paraguensis)*, and various species of pepper *(Piper)*. On the side stages several interesting medicinal plants may be seen, such as the quinine *(Cinchona officinalis)* and strychnine *(Strychnos nux-vomica)*.

In house 9 the plants that yield perfumes are arranged on the south side, one of which, the patchouli plant *(Pogostemon Heyneanus)* is used by the Hindoos for perfuming cashmere shawls. The middle stage is occupied by economic plants used in various industries.

House 8 contains the collections of oils, gums and resins, including the oil of cloves *(Pimenta acris)*, olive oil *(Olea europæa)*, camphor oil *(Cinnamomum Camphora)*, tea oil *(Camellia Sesanqua)*, gum arabic *(Acacia arabica)*, kutteeria gum *(Acacia leucophlæa)*, anime resin *(Hymenæa Courbaril)*. On the side stage a few Mexican rondeletias are in bloom, their pink flowers somewhat resembling the common lantana. Entering the agave house a small group of the "Crown of Thorns" *(Euphorbia splendens)* will be noticed, their small scarlet flowers contrasting with the thorn-like growths. In the desert house some interesting succulent plants, "hen and chickens," are on exhibition, their flowers varying in color from white to orange red. An unusual cactus-like geranium *(Pelargonium echinatum)*, native of South Africa, is blooming at the present time.

Acacia House. The two large specimens of the "bottle-brush" *(Calliandra Tweedii)* are beginning to produce their bright scarlet, brush-like flowers. A close examination will reveal the fact that it is the mass of filamentary stamens and pistils which gives the bright color, and not the sepals, which are insignificant and of a pale green color. *Acacia spadicigera*, one of the mymecophilus plants, is producing its new growth, including the bihorn-like thorns. These thorns are frequented by ants in the plant's native habitat of Brazil, and the association is supposed to be of mutual benefit.

Bromeliad House. *Aechmea Barleei* and several species of *Tillandsia* have flowered, the bright-colored bracts at once attracting attention. The vanilla beans are ripening rapidly and give off an abundance of perfume.

orchid *(Cattleya Trianæi)*, upwards of 250 individual blooms having appeared. Thirty-two different varieties of Burmese lady's slipper orchids are in full flower, several plants having as many as six blossoms. The rare species *Cypripedium insigne Sanderæ*, a native of north India, has produced three flowers of a rich yellow color. Various other interesting genera which are in flower are the Star of Bethlehem *(Angræcum sesquipedale)*, with its ivory, wax-like flowers, the long spur or nectar tube measuring 14 inches in length; *Angræcum Humblotii*, with greenish white flowers hanging down from its peculiar leaves; the bird's bill orchid *(Oncidium ornithorhynchum)*, its small mauve flowers produced from pendant racemes; the yellow-flowered oncidium *(Oncidium splendidum)*, its large yellow flowers contrasting with the golden fern beneath; the butterfly orchid *(Oncidium Papilio)*, with mottled lateral petals resembling the wings, and the linear sepals the antennæ, of a butterfly; *Masdevallia tovarensis*, with pure white flowers, and *Pleurothallis villosa*, the hair-like bloom almost hidden by the ovate leaves. On examining the tiny flowers, the lip will be seen to oscillate with the least movement of the air. Various other species are in flower, totaling 64 species and varieties for the month.

East Indian House. The bright red flowers of *Anthurium Reynaldsianum* and the clusters of scarlet seeds of *Schismatoglottis Rœbelinii* give a little color to the house. The bird of paradise flower *(Strelitzia reginæ)* has been much admired, a series of eight flowers coming from a spathe-like bract at intervals of about three days. The orange-colored perianth resembles, in a general way, the wings, and the sagittate lip the beak, of the bird of paradise. This plant is a native of Africa, where it grows to a height of 6 feet, and is much prized by the Kaffirs, who eat the ripe seed.

Cycads. Several of the cycads are showing fruit, such as *Encephalartos Altensteinii, Ceratozamia mexicana longifolia* and *Zamia chigua.* The whole collection has been transplanted into tubs and removed to the new conservatories, excepting the two largest species of *Encephalartos,* which are now in the Linnean House.

THE CURATOR OF THE HERBARIUM.

Dr. Jesse More Greenman has been appointed Curator of the Herbarium and Associate Professor of Botany in Washington University. Dr. Greenman received the degree of B. S. from the University of Pennsylvania in 1893, where he was

likewise Harrison Fellow until he resigned to accept the Assistantship at the Gray Herbarium of Harvard University in 1894. He took his Master's degree from Harvard in 1899 and the degree of Ph. D. from the University of Berlin in 1901. He held the John Thornton Kirkland Fellowship from Harvard in 1899-1901 and was instructor in Botany in that University from 1902-1905. Previous to coming to St. Louis he was Assistant Curator, Department of Botany, of the Field Museum of Natural History, Chicago, and also held an Assistant Professorship in Botany at the University of Chicago. Dr. Greenman is a Fellow of the American Association for the Advancement of Science, member of the Botanical Society of America, the American Museum Association, Botanists of the Central States, New England Botanical Club and Sigma Xi. He has published "Monographie der nord- und centralamerikanischen Arten der Gattung Senecio;" "Revision of Galium;" "New or Noteworthy Spermatophytes from Mexico, Central America and the West Indies;" "Diagnoses of Spermatophytes chiefly from Mexico and Central America;" "New Senecioneæ from Cuba." Also in joint authorship with Dr. B. L. Robinson, numerous papers on the flora of western and southwestern United States, Mexico and Central America. He is recognized as an authority in systematic botany both in this country and abroad, and his specialization in the flora of the southwest makes him particularly fitted for the development of this field, which is contemplated in the near future by the Missouri Botanical Garden.

THE HERBARIUM.

The herbarium, including all groups of plants, contains approximately 700,000 mounted specimens. Its origin dates from 1858, when Mr. Henry Shaw, the founder of the Garden, at the instigation of Dr. George Engelmann, authorized the purchase of the private herbarium of Professor Johann Jakob Bernhardi, of Erfurt, Germany. After being fully organized the Bernhardi herbarium was found to consist of nearly 70,000 specimens; and while the majority of the plants are native European species, yet the collection contains a relatively large percentage of American plants which were obtained on early expeditions to this country in the latter part of the eighteenth and the early part of the nineteenth

Professor F. Lamson-Scribner, who has examined in detail the grasses of the Bernhardi herbarium, writes as follows: "This collection is especially valuable to American botanists, as it includes a large number of American species and has recently become even more interesting to the student of American plants, as it embraces very many species of our newly-acquired territory in the far east — the Philippine Islands." The plants to which Professor Scribner refers are those cited in Presl's *Reliquiæ Haenkeanæ,* and collected by Dr. Thaddeus Haenke on his voyages of exploration late in the eighteenth century, during which time he visited the Pacific Coast of North America and made collections of plants at various stations between Alaska and Chili, as well as in the Philippine Islands. The type, or original material, from which the descriptions of Presl's species were drawn, are at the Botanical Museum in Prague, and duplicates were placed in the herbarium of the University of Vienna and in the Royal Museum at Munich. A duplicate set also found its way to the Bernhardi herbarium. How complete this set may have been or how extensively the Haenke plants are represented in other groups than the grasses is impossible at present to say; but concerning this group Professor Scribner states further: "Of the 334 species of grasses described by Presl, 121 are represented in this collection. For all essential purposes these co-types, as they would now be designated, have practically the same usefulness for comparison and study as the actual type specimens in the Botanical Museum at Prague."

Among other noteworthy individual collections in the Bernhardi herbarium, and of almost equal interest to American students, are a considerable number of Schiede and Deppe plants, collected in southern Mexico in about 1828 and referred to by Hemsley in the *Biologia Centrali-Americana,* the Martius and the Blanchet plants of Brazil, which are cited in Martius' *Flora Brasiliensis,* thus rendering them of more than ordinary value.

Soon after the Bernhardi herbarium was acquired a very substantial addition was made to the Garden collections by a most magnanimous gift from Dr. George Engelmann of his entire private herbarium, comprising nearly 100,000 plants which, to a large extent, were gathered from southern and western United States. These two herbaria have formed the basis from which the present Garden herbarium, through generous gifts, purchases, exchanges and collections made by members of the staff, has been developed to its present status,

ranking as one of the first four American herbaria, namely along with Harvard, the New York Botanical Garden, and the United States National Herbarium.

The Anual Report for 1912 enumerates several of the private herbaria which have become a part of the organized Garden herbarium as follows:

The George Engelmann Herbarium		97,859	specimens
" J. J. Bernhardi	"	68,134	"
" Henry Eggert	"	26,704	"
" J. H. Redfield	"	16,447	"
" Sturtevant & Smith	"	7,446	"
" Gustav Jermy	"	6,177	"
" A. W. Chapman	"	3,536	"
" Julien Reverchon	"	17,210	"
" Nicholas Riehl	"	3,359	"
" A. F. Eby	"	5,069	"
" S. M. Tracy	"	4,393	"
" William Trelease	"	11,000	"
" J. T. Joor	"	4,133	"
From other sources		427,239	"
TOTAL		698,706	specimens

Of these the Engelmann, Eggert, Jermy, Joor, Reverchon, Riehl and Tracy collections are largely from the lower Mississippi Valley and the southwest. And in addition to these a few of the more noteworthy and representative series of *exsiccati* from the same general region and extending into Mexico may be mentioned as follows: Berlandier, Texas and New Mexico; Gregg, northern Mexico; Lindheimer, Texas; Parish, southern California; Abrams, southern California; Orcutt, southern and Lower California; Pringle, Arizona and Mexico; Blumer, Arizona; Bush, Craig, Davis, Letterman and E. J. Palmer, Missouri; Wright, New Mexico; E. Palmer, Arizona and Mexico; Parry and Palmer, Mexico; Wislizenus, New Mexico and Mexico; Mumford, Texas; Lemmon, Purpus and Wilcox, Arizona; Jones, Arizona and Utah; Fendler, Greene, Heller, Metcalfe, Standley and Wooton, New Mexico; Carleton, Kansas; Baker, Crandall, Hall and Harbour, Parry, and Patterson, Colorado; Kellogg, Arkansas, and J. G. Smith, Texas and Mexico.

A complete inventory of all the collectors whose plants are represented in the herbarium would embrace the names of most American botanists and others who have made collections of plants during the last seventy years; but those names and collections mentioned indicate very clearly that

excellent opportunities for a detailed study of the flora of that region.

While the growth of the Garden herbarium has been naturally and to a great extent from the southern and western parts of the United States, yet to the general collection have been added important series of plants from all parts of the world, resulting in a well-balanced herbarium and serving the purpose of an institution of its kind, namely, to furnish in permanent form the means for advancing a knowledge of plants, particularly their identity, natural relationships and geographical distribution.

THE EASTER BULB DISPLAY.

Although Easter week comes unusually early this year, the Garden is preparing to exhibit a large and attractive lot of plants suitable to the season. Over 500 Easter lilies will be in bloom and thousands of the finest varieties of hyacinths and tulips will be shown, including such novelties as the Tulip Noire, the blackest of all tulips, even a shade darker than the Sultan, and Viridiflora, a tulip with flowers of green edged with yellow. Especially noteworthy will be the collection of daffodils and narcissi, many of which have not been exhibited in this country before. Among the varieties now about ready to be brought into flower are the following: Yellow and sulphur-colored trumpet daffodils, white trumpet daffodils, bicolor trumpet daffodils, large chalice-cupped daffodils, short-cupped daffodils, eucharis-flowered or silver-white fragrant star narcissi, cyclamen-flowered daffodils, bunch-flowered or polyanthus narcissi, true poet's narcissi, and the hoop petticoat or medusa's trumpet daffodils. In addition, calla lilies, amaryllis, spiræas and primroses will be displayed in profusion.

THE GARDEN OPEN EASTER SUNDAY.

By vote of the Trustees the season of open Sundays, instead of beginning with the first Sunday in April, will be inaugurated Easter Sunday. Consequently, from March 23 until December 1, the Garden will be open on Sunday from 2:00 p. m. until sundown.

THE INTERNATIONAL FLOWER SHOW.

The Third International Flower Show will be held in the new Grand Central Palace, New York City, April 5-12. The

Society of American Florists and Ornamental Horticulturists, with some twenty-five other organizations, including the American Carnation Society, American Gladiolus Society, American Rose Society, American Sweet Pea Society and Perpetual Flowering Carnation Society of England, will co-operate with the International Exposition Company to make this the most notable exhibition of flowering and foliage plants ever held. Numerous foreign collections will be represented, and the American growers, both private and commercial, are making elaborate preparations for the show. The Missouri Botanical Garden will exhibit several novelties never before displayed, and in addition the Trustees have offered a prize of $500 to be awarded for the most meritorious plant, either flowering, foliage or economic, which is absolutely new to commerce.

THE ENGELMANN BOTANICAL CLUB.

The following program of meetings to be held in the Graduate Lecture Room of the Missouri Botanical Garden, Tower Grove and Botanical avenues, is announced by the Engelmann Botanical Club. They are open to the public, and the Saturday afternoon sessions will include demonstrations in the Garden.

Monday, February 10, at 8:00 p. m.

Dr. J. M. Greenman.—Classification with reference to Herbarium and Garden Collections.

Mr. W. W. Ohlweiler.—Arrangement of Plants in the Missouri Botanical Garden.

Monday, March 10, at 8:00 p. m.

Dr. Geo. T. Moore.—The Missouri Botanical Garden.

Dr. B. M. Duggar.—Noteworthy European Botanical Gardens.

Saturday, April 12, at 3:00 p. m.

THE CYCADS.

Dr. G. R. Hill.—Fossil Cycads.

Mr. J. R. Schramm—Relation of Cycads to other Plants.

Saturday, May 10, at 3:00 p. m.

AMARYLLIDACEAE.

Mr. C. H. Thompson.—Habitat and Distribution; Botany of Genera; Garden Collection.

Mr. M. Schiller.—Growing of Succulent and Bulbous Plants.

Saturday, June 7, at 3:00 p. m.

ROSES.

Mr. A. Jaenicke.—Species and Distribution; Evolution of Hybrid Roses.

Mr. C. W. Garrett.—Growing of Hardy Roses.

Mr. C. A. Haltenhoff.—Forcing Roses.

STATISTICAL INFORMATION FOR JANUARY, 1913.

GARDEN ATTENDANCE:

Total number of visitors.....1,457

EXCHANGE SEED DISTRIBUTION:

Total number of packets 98

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought.... 55
Total number of books and pamphlets donated... 166

HERBARIUM ACCESSIONS:

By exchange—

U. S. National Museum—miscellaneous N. A. plants..... 604
U. S. Department of Agriculture—N. A. plants..... 215
J. Fowler—Canadian plants 235
George D. Butler—California plants..... 288
H. H. Hall—California plants..... 6

By purchase—

Aven Nelson—Plants of Idaho..... 429
J. M. Holzinger—N. A. Mosses..... 27
Barlow—Plants of New Mexico 22

By gift—

C. O. Rosendahl—Minnesota plants	6
W. W. Jones—Montana plants	18
E. E. Sheriff—Illinois plants	8
H. Leveille—Onagraceæ	12
A. M. Huger—North Carolina plants	4

From various sources—

C. H. Thompson—cultivated plants	32
Moses Craig—Missouri plants	17
Miscellaneous	118
TOTAL	2,041

The Garden is open to the public Sundays from Easter Sunday to November 30, 2:00 P. M. until sunset. Week-days the year 'round from 8:00 A. M. until one-half hour after sunset. Admission free.

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Director,
GEORGE T. MOORE.

Assistant to the Director,
JACOB R. SCHRAMM.

BENJAMIN MINGE DUGGAR,
Plant Physiologist.

HERMANN VON SCHRENK,
Plant Pathologist, *Honorary.*

JESSE M. GREENMAN,
Curator of the Herbarium.

CHARLES H. THOMPSON,
Assistant Botanist.

GEORGE R. HILL,
Research Assistant.

CORA H. THOMPSON,
Curator of Library.

JAMES GURNEY,
Head Gardener, *Emeritus.*

ADOLPH JAENICKE,
Head Gardener.

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THE MISSOURI BOTANICAL GARDEN.
BUILDING FOR ADMINISTRATION, COLLECTIONS, AND SCIENTIFIC WORK.

Missouri Botanical Garden Bulletin

Vol. I | St. Louis, Mo., March, 1913 | No. 3

THE LABORATORIES IN THE MISSOURI BOTANICAL GARDEN.

Botanical laboratories are the work-shops of those who study plants scientifically. They are meant for research and instruction, and are consequently a necessary part of any modern botanical establishment. Other things being equal, those laboratories are most favorably located which enjoy to the fullest extent the facilities offered by such rich collections of living plants as are maintained for scientific as well as for exhibition purposes in the best botanical gardens. Generally speaking, the garden feature of botanical work is appreciated by the public, since the living plants are interesting in themselves; nevertheless, friends of the Missouri Botanical Garden and of the scientific work may be interested in a brief account of the development of the laboratories and of the nature of the work for which they are being equipped.

Botanical Gardens Educational.—In the first place it is to be remembered that the important botanical gardens of the world are educational institutions, and for the most part they represent much of the botanical endeavor of a state or university — garden, laboratories and museum constituting what are collectively known as the "Botanical Garden," or the "Botanical Institute." In the case of the Missouri Botanical Garden, certain phases of the work are intimately and appropriately connected with Washington University, through the Henry Shaw School of Botany, in which all graduate students working at the Garden are registered. This affiliation, effected by the founder, and strengthened by the development of research in the Garden, is obviously of the greatest mutual benefit. The Garden offers its whole facilities to serious students, and the University, charged with the maintenance and development of rational educational standards, encourages breadth of educational achievement.

The Laboratory [illegible]

is often not distinct from "garden" or "park," and thus conceived it connotes merely an extensive plant display, arranged perhaps both in the open and in plant houses. It may be assumed that the display is designed to give pleasing effects, to disseminate the type of information which mere contact with plants may afford, and perhaps to encourage certain more serious studies. Exhibits of blossoming or foliage plants and displays of the natural groups of native and exotic floras are, indeed, an important part of the broad educational plan contemplated and carried out by modern scientific gardens, but this is not all. These collections of living plants facilitate instruction and stimulate research; but the serious study of the incompletely known life processes of plants, or the attainment of a better knowledge of form and structure as a means of classification and further fundamental study, are necessarily conducted in special laboratories.

In the broadest sense these laboratories must represent the possibility of using apparatus and chemicals, books and herbarium specimens, live material from garden or field and cultures of microscopic organisms. The laboratory method in physiological botany is distinctly experimental. Often the experimental work must be carried into the greenhouse and field, for we must grow plants if we are to know their requirements. Since experimental work in laboratories became a feature of botanical instruction, fundamental scientific work has moved by leaps and bounds. Applied botany has profited correspondingly.

Applied Botany.—The training which men have gained in the plant laboratory is that which has enabled them to work out so satisfactorily in recent years many of the important problems in the plant industries, that is, in the application of botanical science to floriculture, to fruit culture and field work, to the encouragement of crop work under semi-arid conditions, to problems of soil fertility, to the prevention of plant diseases, and to numerous bacteriological problems. Nevertheless, immediate application of scientific work is not the chief end, for broad principles are necessary before accurate individual diagnosis is attainable. Applied botany deserves always the fullest consideration and it likewise offers many of the most interesting problems of the day; thus the study of the bacteria and the determination of the function of the root "nodules" of the clover family has allayed all fear of a "nitrogen famine" in the soil, and the grower has a logical basis for the practice of crop rotation; scientifically a new conception of the relation of many lower organisms to

EAST END OF CONFERENCE ROOM—HEADQUARTERS FOR GRADUATE STUDY AND MICROSCOPIC WORK.

nitrogen was made possible and thus, too, further new economic possibilities were at the same time opened.

Laboratories Originally Contemplated.—The establishment and equipment of laboratories and the assembling of a staff of investigators at the Missouri Botanical Garden was not only contemplated by the founder as a possible feature of the work, but these things were expressly specified as a part of the purpose of the establishment. By the terms of his will and by plans which had a definite inception prior to his decease, Mr. Shaw offered every encouragement to the development of laboratories and the promotion of research, both in the Garden and in the School of Botany.

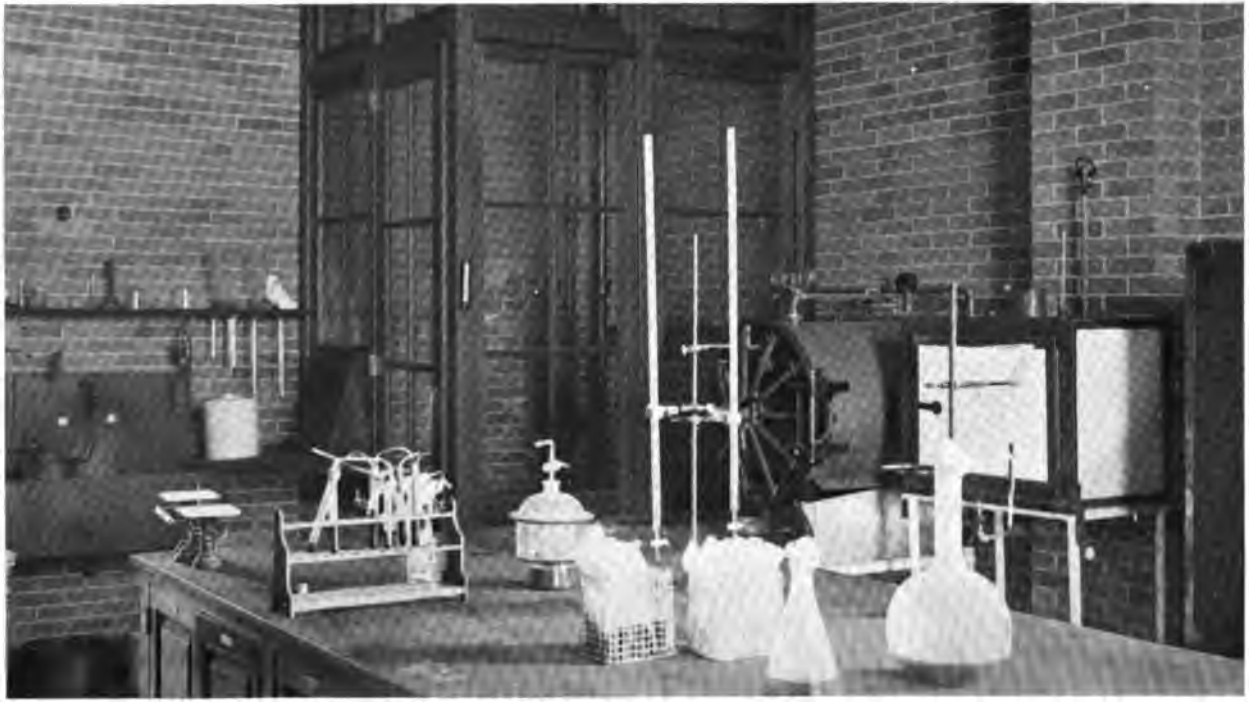
With the appointment of Professor William Trelease as Director of the Garden, in 1889, research was inaugurated, meaning by this not only an adequate expenditure for the maintenance of the Garden proper, but also for the augmentation of the facilities of the library and herbarium, likewise for the establishment of a laboratory, and the organization of a research staff. An evidence of the expected attitude of the Garden towards research is afforded by the address of Professor Farlow at the first annual banquet, in 1890, where he said, in part:

"Now you have here in St. Louis a garden with an endowment far surpassing that of any other garden in America, and possibly equaling that of the best gardens in Europe, with a fund which may be and should be spent for the purposes of investigation. Here in St. Louis, better than anywhere else, you are provided for doing abstract work. Trust to research. Do not be afraid to go ahead and leave to investigators the work which in the end, and perhaps in a comparatively few years, must give your garden a prominent place amongst all the gardens of the world. Do not be content to say 'We of St. Louis have here a beautiful garden where we can go every day and examine the plants and appreciate the beauties of nature,' but do not rest until you have established here a school of research, research in the most difficult problems of botany, being assured that in the end those problems will be of advantage not only to St. Louis, to Missouri, but to the whole world. Once having made in St. Louis a school of research, you will then take the lead in practical horticulture as well as in more purely theoretical science."

work have succeeded in the encouragement of research, even before special laboratories were set apart, is clearly shown through the scientific contributions which have appeared in the Annual Reports of the Garden and in other botanical publications. The extent of the impetus for research during the present year is made apparent by the fact that, including graduate students, and exclusive of visiting botanists, no less than fourteen persons at the Garden are now devoting some of their time to investigation. Moreover, since 1889 the library and herbarium have grown rapidly and now represent a wealth of capital available to present and future botanical and plant industry workers. The library, comprising about 70,000 books and pamphlets, is, perhaps, the largest botanical library in the country collected in one building.

Up to 1903, however, it had not been found possible to designate any building or room especially for experimental laboratory work. In that year the basement of the museum building was equipped as a plant pathological and chemical laboratory, the equipment being provided through the co-operation of the Bureau of Plant Industry, U. S. Department of Agriculture. Later co-operation was also arranged with the Forest Service. It was known as the Mississippi Valley Laboratory of the Department of Agriculture. The laboratory was in charge of Dr. Hermann von Schrenk, and as a result of his work, and that of his associates, important contributions have been made to our knowledge of plant diseases,—in fact, the work represents the first systematic study of timber diseases in this country. Here also the important problem of timber treatment received scientific attention. Co-operation with the Department of Agriculture was discontinued in 1906, but Dr. von Schrenk was subsequently appointed honorary pathologist to the Garden, and this laboratory for plant pathology and chemistry has been maintained in the museum building.

The Laboratory Building.—A chief augmentation of the facilities for research and graduate instruction was effected when, in 1909, there was completed an extensive fireproof addition to the library and herbarium building, more than doubling the size of the former structure. The south wing of this structure was set apart primarily for laboratory purposes. At the same time Dr. George T. Moore was appointed to the professorship in physiology and applied botany. In connection with this professorship two research fellowships were established, and in the following year three more were added, all five being designated the Rufus J. Lackland Re-



VIEW IN THE STAFF RESEARCH LABORATORY.

search Fellowships. It should be noted that the purpose of these fellowships is to encourage young men and women of ability, graduates of colleges and universities, and trained in science, to enter upon investigation work in physiological and other phases of botany. The Fellows may also be called upon to assist to some extent in both instruction and departmental research. With a change of administration, in 1912, Dr. B. M. Duggar was appointed Professor of Plant Physiology, to devote his time to research and to the direction of graduate work.

While the laboratories are arranged for any phase of botanical study, special attention is being given to the requirements of both physiology and taxonomy in their broadest relations (see special announcement of the Shaw School of Botany). The appointment of Dr. J. M. Greenman as Curator of the Herbarium and Associate Professor of Botany (noted in the previous number of the BULLETIN), and the more recent designation of Dr. E. A. Burt as Mycologist and Librarian, make possible the rapid development of the taxonomic side of the work.

The Laboratories and the Equipment.—In the building devoted to research and graduate instruction the first floor is occupied by the office and lecture room. On the second floor are found a staff research laboratory, a balance room, and a large conference room which serves at present as headquarters for study and microscopic work of twelve graduate students —likewise as Seminar room. The third floor is given up to general experimental laboratory work, being made up of two small research rooms and one large laboratory. A spacious basement is used for storage and rougher phases of the work. In the preceding description no reference has been made to the herbarium, this having been treated at length in the last BULLETIN.

The equipment of the laboratories proper was begun in 1909 and has since been materially strengthened. Besides microscopes, microtomes, paraffin bath, and other apparatus required in almost any phase of botanical work, there is a complete bacteriological equipment. This includes transfer rooms with steam connections for dust precipitation, one upright and one large Kny-Scheerer horizontal autoclav steam sterilizers, dry ovens, incubators, ice chest, etc. The equipment for special physiological study includes further a spectroscopic outfit, photo-micrographic outfit, instruments for the measurement of environmental conditions, a large

four-chamber incubator, built especially for physiological work, glass incubators for growing algæ, a D'Arsonval galvanometer and much smaller apparatus. Furthermore, facilities for the development of the physiological-chemical side of the work are being rapidly increased, and these include apparatus for enzyme and general fermentation studies, including a Hill pressure filter for extracting plant juices, a nitrogen still, gas furnace, balances, the necessary glassware and chemicals, as well as other general facilities required. An effective water still with a capacity of seven gallons an hour has also been installed.

The abundance of material in the Garden and greenhouses offers special opportunities for the solution of diverse botanical problems. Greenhouses are also maintained for the experimental work, but houses especially adapted to the needs of experimental physiology and pathology constitute the next important material advance in the development of the research equipment. There is very close contact between all phases of garden endeavor; especially is a spirit of complete co-operation expected to prevail between the Garden work proper and research and instruction.

Investigation and Reports.—Besides the regular staff, the assistants, Fellows, and other graduate students who are now engaged in research are as follows: J. R. Schramm, A. B., Wabash College, Assistant to the Director; George R. Hill, Jr., Ph. D., Cornell University, Research Assistant, formerly Instructor in Plant Physiology at Cornell University; W. W. Ohlweiler, B. S., Connecticut Agricultural College, Teaching Fellow; J. S. Cooley, M. S., Virginia Polytechnic Institute, Lackland Research Fellow, formerly Assistant Plant Pathologist at the Virginia Agricultural Experiment Station; A. R. Davis, A. B., Pomona College, Lackland Research Fellow; Margaret De Meritt, M. S., New Hampshire College, Lackland Research Fellow, formerly Assistant in Botany, New Hampshire College; W. H. Emig, A. B., Washington University, Lackland Research Fellow; L. O. Overholts, A. B., Miami University, Lackland Research Fellow; C. O. Chambers, A. M., University of Indiana; A. G. Nolte, B. S., Washington University; Mildred Spargo, A. M., Washington University.

Aside from the important work in the taxonomy of the flowering plants now in progress, some of the problems which are being investigated in the laboratories are the following:

SOUTHEAST CORNER OF CONFERENCE ROOM.

A CORNER OF THE EXPERIMENTAL LABORATORY NOW BEING EQUIPPED FOR GRADUATE PHYSIOLOGICAL-CHEMICAL INVESTIGATIONS.

The role of soil conditions in determining the susceptibility of certain plants to some important fungus diseases.

The effect of smoke upon various forms of vegetation, with special reference to the determination of the comparative injury to different plants, and the use of certain easily-injured plants as indicators in determining areas affected.

A continuation of some studies upon the effect of certain gases on fruits and vegetables; an endeavor to determine the value of ventilation in the shipment and storage of fruits and storage products; the effect of the wrappers on transported fruits.

The relation between certain algæ found commonly in the soil and the fixation of free nitrogen; an attempt to throw further light on the relation of algæ to certain phases of the soil fertility problem.

A monographic study of the native polypores of Missouri. The polypores are corky fungi, including many of the more important organisms causing forest tree diseases and timber decays.

A study of the physiology of the common damping-off fungus of greenhouse cultures and seed beds, with special reference to the conditions influencing the activity of the parasite.

The pathological importance of wild species of yeasts. A considerable number of yeast species have been obtained from various sources and an endeavor will be made to determine the possible relation of those to certain abnormal animal growths.

A study of the life history and physiology of Chlamydomonas, one of the most primitive organisms of the vegetable kingdom.

The toxicity of aluminum compounds towards plants.

The effects of conditions on the development of pigments in plants, with reference also to the factors causing the intensification of coloration in certain structures.

The effects of certain fungicides and spray mixtures on the physiological activities of leaves.

relatively the degree of pollution of air in closed public conveyances, in factories, etc., especially by the presence of certain common indicator bacteria.

A representative of the Illinois State Laboratory of Natural History, Mr. R. E. Richardson, has been spending some months at this laboratory engaged upon a study of biological material collected in the Chicago Sanitary Canal and Upper Illinois River, preparatory to an extensive report upon that subject.

In general it may be said that the field now covered by the investigations undertaken at the Garden is a very broad one, and the details of the work can only be apparent through the articles published. It may be well to state that the general attitude of the research staff toward the types of problems for investigation is a broad one—no legitimate scientific problem is too practical or too abstract. There is no reason why an investigator connected with the laboratory should not equally well study "How to produce a new rose" or "Correlation and segregation phenomena in rose hybrids"; "How to store vegetables and fruits" or "Respiration and changes in tissues preserved at low temperatures."

One evening a week is devoted to a Seminar comprising members of the staff and graduate students, who report upon their work and endeavor not only to correlate their efforts, but likewise to follow and discuss the progress of cognate studies in other scientific laboratories. The Engelmann Botanical Club, which has been in existence more than a decade, holds monthly meetings in the laboratory building, and the membership of this body has increased during the present year. This Club is designed to bring together for mutual benefit all those in the city who have general professional or scientific interest in botany.

HINTS ON LAWN-MAKING IN ST. LOUIS

No one thing so adds interest and charm to a landscape as a well-proportioned lawn. Given a good stretch, it is comparatively simple to add flowers and shrubs in pleasing combination, but without the grass it is impossible to secure the restful effect so much desired in any scheme of planting. This principle is well known, and a lawn properly made and maintained is recognized as being the key to the satisfactory setting of any building, be it small house or most pretentious public structure. The efforts of the gardener are not always

attended with success, however, and since the number of inquiries relative to the proper making and care of a lawn are constantly increasing, it seems desirable that a few of the fundamental principles of grass-growing be set forth for the benefit of the readers of the BULLETIN.

Of course there are many different uses to which a lawn may be put, and the character and treatment varies somewhat according to the specific end desired. The only kind of lawn which will be discussed here is that which the householder is anxious to secure, leaving the peculiar requirements for golf links, parks and similar special localities to some future time.

THE SOIL.

The ideal soil for lawn grasses is one which, while remaining moist, never becomes saturated with water. Thus a clay or sandy loam, with a clay subsoil, is much better adapted to the purpose than a light, loose soil, which dries out rapidly. Unfortunately, the land around a new house is not usually well adapted for a lawn, owing to its being mixed with the subsoil which has come from the excavation, or the undesirable earth which is hauled in for grading. It is often necessary, therefore, to spend a year or more in getting the earth into proper condition before seeding it for a permanent lawn. While this may seem a waste of time, it must be remembered that the life of the lawn depends to a large extent upon the character of the soil, and that more can be done in one year before the grass becomes established than in many years afterwards. Nothing is lost and everything is to be gained by as nearly as possible getting the soil into proper condition before permanent seeding.

PREPARATION OF THE SOIL.

In making a lawn for the first time on light, sandy soil, two or three inches of clay incorporated with the first four to six inches of sand will be of the greatest benefit. Stable manure at the rate of twenty to thirty loads per acre will assist in furnishing the necessary humus, and if a crop of legumes, such as cow-peas, can be grown and then turned under, the beneficial result will more than pay for the delay and expense.

Practically all lawn grasses prefer an alkaline soil, and in

to a ton per acre may be used, or there are certain advantages in applying crushed limestone rock at about double the proportions employed for air-slaked lime. The rock remains available in the soil much longer, and under ordinary circumstances gives up a sufficient amount of alkali to maintain the desired condition. Hardwood ashes at the rate of a ton to the acre are sometimes used with good effect, as they assist materially in correcting the acidity of the soil. Raw crushed bone, five hundred pounds or more to the acre, may be used in the original preparation for a lawn, and the usual combinations of chemical fertilizers are all useful. Stable manure is, for light soils, greatly superior to chemical fertilizers, since it not only adds a sufficient amount of plant food, but likewise improves the texture and water-retaining capacity of the soil. It should be borne in mind that it is impossible to get a soil too good for a lawn, and that there is every necessity for taking great pains at first, since the grass is to be a permanent crop.

WHAT SEED TO SOW.

The ideal grass for a lawn should have a creeping underground stem with short joints, producing long, narrow leaves in abundance, making a close turf. In addition, the color should be pleasing and permanent, that is, not changing radically through the seasons, and the more drought-resistant it is, the better. In addition, it must stand repeated cutting and should be adapted to as large a variety of soils as possible. Kentucky bluegrass *(Poa pratensis)*, not Canadian bluegrass *(Poa compressa)*, undoubtedly comes nearer to this ideal than any other single grass, and for this reason it forms a part of practically all the mixtures used for the purpose under discussion. Unfortunately, bluegrass does not stand well the summers of St. Louis, and it is a fact not generally recognized that a good lawn from this grass alone cannot be obtained under three or four years. It has been a much-debated question whether bluegrass should be sown with other grasses or not, but in this locality there can be but one answer, namely, that some mixture combining several of the standard grasses is far preferable to bluegrass alone. It must be admitted at once, however, that there is no such thing as a perfect universal lawn mixture. The conditions under which grass has to grow in different localities and the varying tastes of individuals has resulted in a number of formulas being suggested which may or may not prove successful when used by different planters. Bluegrass not only

requires several years in which to become thoroughly established, but it does not grow as closely to the ground as some other varieties, and in order to have a green lawn as soon as possible it is absolutely necessary to use a combination of seed. Furthermore, it is a fact that a thicker growth can be obtained from a given area where several kinds of grasses are growing than where one is alone.

A mixture which has been widely used and which, under favorable conditions, gives satisfactory results, is the following:

Fancy Kentucky bluegrass	50%
Fancy red top *(Agrostis alba var. vulgaris)*	20%
Rhode Island bent *(Agrostis canina)*	15%
English rye *(Lolium perenne var. tenue)*	15%

Such a mixture should be planted at about the rate of one pound to every four hundred square feet, or one hundred pounds (five bushels) to the acre.

English rye starts almost as soon as sown, and in a month or six weeks will present a uniform green appearance. It is not a long-lived grass, and will be obliterated during the second season, but is worth while on account of the immediate and satisfactory results obtained. The red top stands hot weather well, grows rapidly and is not easily killed out. Rhode Island bent is the basis of the famous Newport lawns and makes a strong turf which will stand tramping well. It also acts as an admirable "nurse" to the bluegrass.

Tastes differ as to the desirability of white clover *(Trifolium repens,* var. *perenne)* in a lawn. Some think it adds to the beauty of a greensward, and other strongly object to its appearance, considering it out of place. In its favor it may be said that white clover produces a dense, quick growth, and will often make a green covering where grass seed fails. It will not stand rough usage, however. If desired in a lawn it should be sown sparingly, not over two to four pounds to the acre, and separately, for, being heavy, it will be distributed very unevenly if mixed with the other seed.

Various other combinations of seed too numerous to mention might be referred to, but space will not permit. There will be started this spring at the Garden a number of experi-

special attention will be paid to lawns for wet, sandy, clay and shady locations, as well as those for putting greens, fair greens, etc.

TIME TO PLANT.

The greatest difference of opinion exists as to the relative advantages of spring and fall planting of lawns. Both periods have been repeatedly shown to bring successful results, and it is largely a matter of the weather conditions existing after the putting in of the seed which determines failure or success. If one could be certain of the kind of winter or spring which was to follow the making of the lawn, it would be comparatively simple to decide upon the best time to plant. As it is, seeding should depend upon convenience, and chances must be taken on the result. In general, it may be said that spring planting is more certain than fall planting, unless, owing to weather conditions, seeding has to be delayed too long. Drought and heat are hard on young plants which have not had time to form sufficient roots. It is not advisable to sow seed during a dry period either in spring or fall. A careful preparation of the land which insures ready germination will sometimes offset the effect of limited dry periods, but artificial watering should always be resorted to if sufficient moisture is not present to force rapid growth.

WATERING.

After a lawn is established, more harm than good is often done by the methods of watering usually employed. Mere sprinkling has a tendency to cause the roots of the grass to grow close to the surface of the soil, and consequently the plants must be almost continuously watered in order to keep them alive. Land properly prepared in the first place will induce deep root growth and, except in unusually dry seasons, no water whatever is necessary. When watering must be done it should consist of thoroughly soaking the earth as deeply as it is dry. Another objection to light sprinkling is that it induces the growth of wild grasses, which cannot thrive under as dry conditions as the standard lawn varieties.

TOP DRESSING.

The most careful and thorough preparation of the soil originally will not obviate the necessity for an occasional top dressing of fertilizer. Stable manure, thoroughly rotted, is admirable for this purpose. Care should be taken, however, to see that it is so completely decomposed that it contains no

weed seed and that it will break up rapidly in order that it may be carried rapidly beneath the surface by means of rains and snow.

As a spring top dressing nothing is better than powdered sheep manure, particularly if it is mixed with lime to conserve the nitrogen, which may otherwise be lost. Apply at the rate of about one ton to the acre. Bone meal and hardwood ashes in equal parts, at the same rate as sheep manure, also produce good results. For quick effects, nitrate of soda, used up to five hundred pounds per acre, is unexcelled. It is usually better to divide the total amount to be applied into three or four lots, applying each lot before a rain. In fact, all top dressing should be put on as nearly as may be possible before a rain in order to insure the washing in of the fertilizer, as well as to prevent the discoloration of the lawn.

CONCLUSIONS.

Don't underestimate the importance of a thorough preparation of the soil before trying to establish a lawn. Most of the failures supposed to be due to poor seed are really because of poor soil.

Don't merely re-seed where grass would not grow before; probably the trouble is with the soil.

Don't plant Kentucky bluegrass alone and expect immediate results. In the course of three or four years a good lawn may be secured, but this will be because of a peculiar combination of good soil, proper treatment and favorable weather, which is not likely to occur.

Don't think you can get an English lawn in St. Louis by importing the varieties of grass seed used in England. The thing can't be done.

Don't fail to use a heavy roller (a thousand pounds is not too much) on a new lawn.

Don't cut a young lawn too close. Set the knives of the lawn mower high and keep the grass about two inches above the crown.

Don't top dress with fresh manure. It introduces weeds and is unsightly.

Don't spoil a new lawn with light sprinkling. If water must be added, let it run in a full stream until the soil is thoroughly soaked.

FLORAL DISPLAY.

As announced in the February number of the BULLETIN, a large Easter display of flowering bulbous plants comprising tulips, lilies, narcissi, daffodils and hyacinths, in almost endless variety, will be shown in the north wing of the new plant range. The collection will be in place on Easter Sunday, and may be expected to be at its best during the following ten days or two weeks. Additional variety will be supplied by spiræas, calla lilies and primroses. Following the bulb display—beginning about April 10 to 15—the principal attractions in the floral display houses will be spiræas, calceolaria hybrids, matricarias, ornamental tobaccos, and, somewhat later, roses and hydrangeas. It should be emphasized that at all times other flowering plants will be shown which, because of their number, cannot be enumerated, but which add greatly to the variety and interest of the collections. Among these may be mentioned the gloxinias, with their delicate shades of color, large showy flowers and vivid green foliage, which will begin to make their appearance toward the end of April, though not becoming prominent until May.

STATISTICAL INFORMATION FOR FEBRUARY, 1913

GARDEN ATTENDANCE:

Total number of visitors	1,683

SEED EXCHANGE:

Total number of packets distributed	1,635
Total number of packets received	415

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	17
Total number of books and pamphlets donated	105

HERBARIUM ACCESSIONS:

By Exchange—

U. S. National Museum—Central American plants	6

By Purchase—

A. A. Heller, Oregon, Utah and Navada plants	750
E. Bartholomew—North American fungi	200
I. Urban—San Domingo plants	459

By Gift—

L. H. Dewey—Economic plants	2
J. M. Greenman—Massachusetts, Michigan and Arizona plants	7

From Various Sources—

Miscellaneous	4
Total	1,428

The Garden is open to the public Sundays from Easter Sunday to Nov. 30, 2:00 P. M. until sunset. Week-days the year 'round from 8:00 A. M. until one-half hour after sunset. Admission free.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

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Assistant to the Director,
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In Charge of New Plant Range.

Missouri Botanical Garden Bulletin

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ST. LOUIS, MO.

PUBLISHED

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Missouri Botanical Garden Bulletin

Vol. I St. Louis, Mo., April, 1913 No. 4

PLANTING AND CARE OF SHADE TREES IN ST. LOUIS.

St. Louis has many miles of streets planted with shade trees, of which the city may be justly proud. There are, however, many more miles of streets in which there are practically no trees, or where the trees have been so badly neglected, or are so badly injured, or where they occur so infrequently that they are of little use for shade or ornament. During the past five years a good deal has been done towards the proper care and maintenance of trees in city streets, as well as encouraging the planting of new trees, but much remains to be done. There is no reason why the streets of St. Louis should not be fully planted with shade trees, particularly in the residence districts.

Certain species of trees grow very rapidly, and it is surprising how soon good sized shade trees may be had. The accompanying illustrations show four views, looking east on Flora Boulevard, taken from the main gate of the Missouri Botanical Garden. The first photograph was made in February, 1900, the second and third about the same time, in 1906 and 1907, and the fourth in February, 1913. As indicated in the first photograph, there were very few trees on this street in 1900, and those actually planted were very small. In twelve years this street has become one of the most attractively shaded ones in the city.

In view of the fact that this season of the year is the ideal time for planting new trees, some hints as to the kinds of trees to plant and the conditions under which they should be planted may be timely.

KIND OF TREES TO PLANT.

symmetry and shade-giving habit, immunity to the attacks of fungi and insects causing disease, smoke and drought resistance, cleanliness of habit, and longevity. There is practically no single kind of tree which will fulfill all of these requirements.

The following tree species should receive consideration in St. Louis:

The sycamore is probably the best street tree for general planting, especially the oriental variety *(Platanus orientalis intermedia)*. This tree has all of the vigor and hardiness of the American sycamore, but does not shed its leaves in the same objectionable way. It also has various qualities desirable in the street shade tree, which make it more acceptable than most of the other species. It grows very rapidly, has a straight trunk, forms a round symmetrical head, is perfectly hardy, withstands the smoky atmosphere as well as any other species, and is comparatively free from destructive diseases. At the same time, when properly pruned, it gives a very dense shade.

Next to the sycamore the soft maple stands well in general estimation. Its rapid growth and the readiness with which it can be pruned to any desirable form have recommended it. The wood of this tree is very weak, however, and during severe wind storms, such as occur in the early part of the year, many of its branches are broken. It is, furthermore, very subject to the attack of various insect borers.

The Carolina poplar has been planted on many streets, but is not a desirable tree except when used as a temporary filler, to be removed when the permanent trees, planted on either side, attain sufficient size. For streets located in the outer parts of the city, a more general planting of oaks can be recommended, especially the red or scarlet oak, both of which withstand considerable drought. Norway and sugar maples are also desirable. The chief objection which can be offered to these trees is their slow growth, but where a permanent improvement is made, either of these trees will be found superior to the soft maple.

The tulip tree and white ash both do very well, except

1900.

The elm, which is frequently used as a shade tree in eastern cities, suffers severely during the hot summer season and is also subject to the attack of bark diseases. On that account it is not desirable to plant elms, except in the out-lying regions, where they can be given very special care.

In making a selection as to the kind of tree to plant on a street, consideration should be given to the varieties of trees already existing there. Under an ordinance passed several years ago, anyone desiring to plant a tree on a street must obtain a permit from the office of the City Forester. Under this same ordinance, as recently amended, permission is given to the property owners on any given street to make a selection of a tree species, so that when plantings are made on such street uniformity is assured, making it a more attractive thoroughfare. The revised section of the ordinance, as it is now in effect, reads:

> "If the property holders along any given street, upon due notice so to do from the City Forester, shall fail to make the selection provided for by Section 1254 hereof, within six months next after notice has been given, then it shall be the duty of the City Forester to select a variety of shade trees for such street or blocks of such street which shall thereafter be the only variety which shall be planted on said street or blocks of said street, provided, however, that if thereafter a majority of the property owners on any two or more contiguous blocks shall petition the City Forester to change the selection so made under the provision of this Section to a more suitable variety, and the City Forester approve the change, then the trees planted thereafter on said street or blocks of said street shall be the variety last so approved."

WHEN TO PLANT.

Trees may be planted either in the fall or spring, but for various reasons it will be preferable to plant in the early spring; that is, just as soon as the ground is in a workable condition. This is usually the latter part of March and early April.

WHERE TO PURCHASE TREES.

One of the chief reasons why many of the trees planted in city streets fail to grow properly is that sufficient care and attention are not given to the kind of trees purchased and to the conditions under which young trees are transplanted from a nursery to the street. It is by no means

grow satisfactorily. When a tree is moved from one place to another the greatest care should be exercised to prevent any greater injury to the roots than is absolutely necessary. The best subsequent development will occur where the shortest interval elapses between the time of digging up the tree and resetting it. While, with proper precaution, trees can be successfully transplanted when shipped from a distance, there is no doubt but that the best results are usually obtained where trees are moved as short a distance as possible. It is, therefore, recommended that wherever possible trees be purchased from nursery men in or near St. Louis, so that the least possible time may elapse between the digging of the trees from the nursery to the actual setting in the street. Prospective purchasers of trees should insist on proper protection of the roots of trees which they purchase. The roots should either be kept moist or enclosed in bagging or other material, so as to reduce the drying out during the time of shipment.

HOW TO PLANT.

Before setting any tree the greatest care should be used in properly preparing the place where the tree is to be set. In many of the streets the soil is, unfortunately, not of the best kind, particularly in places where the streets have been filled with ashes and other rubbish. It will be advisable in all cases, where the soil is poor, to dig a hole a good deal deeper than is necessary for the particular tree, and to partially fill this hole with good garden soil. In many of the eastern cities holes 10 to 12 feet in diameter are frequently dug and filled with good soil, so that the young trees when set may start out under the most favorable conditions.

Before setting the tree all roots should be carefully examined, and any broken or bruised ones carefully cut off with a sharp knife. At the same time the branches should be pruned. It is frequently not understood that in transplanting a tree the fine roots are injured and in many cases destroyed entirely. Until a new set of fine roots is formed, the amount of water absorbed by the tree will be very small. In order that this small amount of water may be sufficient it is necessary to prevent an excessive production of leaves. The extent of the pruning of branches for this purpose, which

1907.

as much as oaks, ash or gum, but it is usually safe to over-prune rather than to under-prune.

After the hole has been prepared the tree should be set so that, when finally planted, it will stand in the ground approximately the same depth that it did when growing in the nursery. While filling the hole, care should be used to spread the soil in such manner that it fills all of the spaces between the roots. After the tree has been set, the ground should be carefully and thoroughly tamped. The larger the tree, the more important the final tamping is.

In many streets the soil exposed around a tree is very limited, and the amount of water which can get to the roots is thereby reduced. In such cases it will be found desirable to put in some sort of irrigating system. This may be either in the form of a grill or a tile drain. The use of grills is particularly desirable in places where there is much traffic on the streets. Tile may be installed either by laying a number horizontally to one side of the tree, about a foot and a half under the ground, with a branch tile leading to the surface, into which water can be poured; or a less expensive scheme is simply to put one piece of tile about two feet from the base of the tree, extending down into the ground. Two or three such vertical tiles, depending upon the size of the newly-planted tree, may often be used to advantage. It will be desirable to cover the opening of such tile with a cap to prevent clogging.

After the tree is planted it should be supported in some way. It is all important that the roots be kept fixed, particularly during the two or three months immediately following planting. Small trees may be supported either by driving a good strong stake into the ground at some distance away from the trunk and firmly tying the tree to such stake. In the case of larger trees guy ropes or wires should be attached in such a manner that the tree may stand firm when the wind blows. All young trees which are standing close to the street line should be provided with some sort of guard. Probably the greatest injury to city shade trees is caused by the gnawing of horses, and unless protected by a guard, the life of the newly planted tree is likely to be materially shortened. Young trees should not be wrapped with burlap or other cloth, except under special advice.

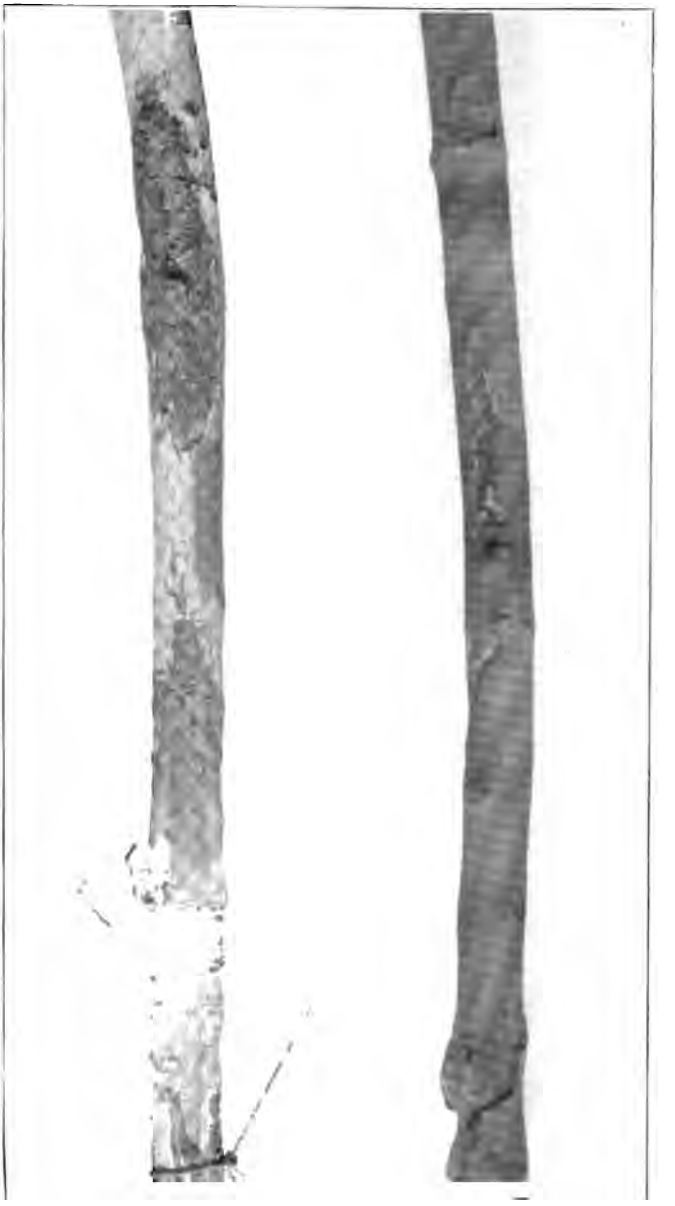
CARE OF TREES AFTER PLANTING.

that they are properly pruned and sprayed. No person should undertake to prune or spray, or in any way to attend to shade trees, unless fully competent to do so. St. Louis has an excellent Bureau at the present time, whose services are free to every citizen. Five years ago a City Forester was appointed, one of whose duties it is to prune and look after all trees planted in the city streets, and to give advice as to the care and attention which should be given trees in streets and on private property within the city. Reference made below to the activities of the City Forester's office will indicate to what extent this department is caring for the trees of the city. One of the chief reasons for the establishment of this office was to prevent indiscriminate pruning of shade trees. Too much stress cannot be laid upon the fact that unscientific pruning does more harm than good. The object of pruning is not only to do away with branches which interfere with the general symmetry of the tree, but also those which retard its proper development. The only one who should undertake pruning is the thoroughly trained man. That which has been said for pruning applies equally well to spraying.

It is true that the force of the City Forester is as yet lamentably small, and only a small portion of the city can be carefully attended to. This does not justify private effort, however, in connection with the pruning and spraying of city trees. In fact a recent ordinance specifically prohibits, under heavy penalty, the pruning, spraying or other interference with city trees, except by special permission of the City Forester. Vigorous effort should be made on the part of all citizens to indorse this act as well as to emphasize the necessity for more extensive work on the part of the city, so that ultimately the City Forester shall be in a position to care for all city trees.

INJURY.

Among the agencies which injure trees in St. Louis, a few of the more notable ones may be mentioned. As already indicated, horses inflict lasting injuries on young trees, and on this account all trees should be carefully protected by guards. Under an ordinance approved February 13, 1911, any person who injures, defaces or damages any trees in any way, including the hitching of horses or other animals



same ordinance it is the special duty of the police to enforce this particular section. Everyone, therefore, who sees trees being injured by horses or other agencies, should report same to the nearest policeman. A vigorous enforcement of this ordinance would do much to increase the respect for shade trees in the city.

BORERS.

Probably the most serious enemy of shade trees is the maple borer, which attacks all species of maples. A recent examination made of a number of trees in the western part of the city showed evidence that practically every maple tree in a stretch of about ten blocks had been attacked by this insect. In a recent report on this borer, Dr. Felt, of the New York State Department of Entomology, says: "While other pests cause much injury, the fact remains that the sugar maple borer *(Plagionotus speciosus* Say*)* is quietly and unobtrusively carrying on its deadly work, and in a series of years probably kills more of these popular shade trees than any other insect pest." According to Dr. Felt, the maple borer attacks trees in full vigor. He says: "The powerful legless grub confines its operations largely to the inner bark and sap wood, and as it runs a burrow several feet long in one season, and as one borer will frequently work transversely half around a tree some eighteen inches in diameter, the dangerous character of this pest is at once apparent." The parent insect is a beautiful stout beetle about one inch long. It is black, brilliantly marked with yellow. The insect lays its eggs in the period from June until August, the favorite place for depositing them being near the base of the limbs. The young borer starts work during the early fall and passes the winter in a shallow excavation in the sap wood. In the second year the borer works extensively, building burrows in an irregular way up and down and around the tree. When the borer is about sixteen months old, it makes a deeper hole, and in this hole transforms to the pupa and then to the beetle. Where two or three borers are working in a tree, they very frequently girdle the tree entirely, resulting in its rapid death. The burrows of the insect can usually be recognized as slight depressions on the surface of the trunk. In St. Louis the borer is especially active on young maple trees. Plate 10 shows parts of the trunks of two trees; the left hand one, planted

bating this insect is to find and "dig him out"; the "digging out" will rarely do more injury than the borer would otherwise cause.

A precautionary measure, which frequently does considerable good, is to spray the trunk and larger branches in the spring and again during June and July with a wash made as follows: Thin one gallon of soft soap with an equal amount of hot water and stir in one pint of crude carbolic acid (one-half pint refined carbolic acid); let it stand over night and then add eight gallons of soft water. Only the most vigorous care and attention, particularly during the months from April to September, will save trees from the disfigurement and eventual destruction by this dangerous insect.

Aside from the borers there are numerous leaf-eating insects which do considerable damage to trees. Chief among these are the bagworms. During the fall and winter the small bags hanging in thousands from the trees in the city are objects readily visible to anyone. Many of these bags contain eggs which hatch out about the time the first leaves begin to form on the trees. The young caterpillars quickly attack the leaves, and before the tree is fully leaved may, in some seasons, entirely defoliate it.

The most effective method of guarding against these insects is to collect the bags in the winter time and burn them. In the spring, after the larvae have appeared, they may be controlled by spraying the trees with a solution of arsenate of lead. This solution may be prepared as follows: Acetate of lead, 12 ounces; arsenate of soda, 4 ounces; water, 15 to 20 gallons. Dissolve the two salts in separate vessels, using small quantities of water, and pour the two solutions simultaneously into the tank containing the 15 to 20 gallons of water.

Various forms of web worms destroy the leaves of shade trees during the latter part of the summer. These insects can be destroyed by cutting out the twigs in which the nests of the caterpillars are located and burning them. It is always better to cut out the twigs than to burn them while on the tree.

During the last few years the soft maple trees in St. Louis

objects, found on the under side of twigs and branches. In the spring they start to excrete a mass of white cottony material. These scales will usally be found several in a cluster, and later on many hundreds of them may be found on a single leaf. The insect can be attacked by spraying with whale oil soap (one pound to two gallons of water when used in the winter time; one pound to four or five gallons of water when used in the summer). The most efficient way is to brush the scales from the trees whenever they are noted.

Fungous diseases of trees are apparently not very prevalent in St. Louis; the few serious forms of leaf fungi not appearing until the latter part of summer. Wood-rotting forms are more common. Their attack usually takes place through wounds caused by improper pruning or by mechanical injuries due to various causes. Where a tree shows hollows or rotten places, the City Forester's office should be notified, so that proper preventive measures may be applied.

RULE OF THE CITY FORESTER'S OFFICE.

During the last year the City Forester's office had an appropriation of $26,725.00. The number of men employed was one forester, one assistant forester, one clerk, two inspectors, four overseers, sixteen laborers, four teams and one spraying machine.

The number of trees cared for on selected streets was 33,828. The number of trees handled during the year, aside from spraying, was 63,022. The number of trees sprayed against leaf-eating insects was 4,749.

The field hands of the Forester's office carried on general pruning on selected streets (meaning by this, streets on which citizens had selected special species of trees). They treated trees for borers, so far as the limited facilities would permit, on all streets where the trees were sprayed against leaf-eating insects. They cultivated all young trees on selected streets, removed low-hanging branches and dead and dangerous trees from all streets; inspected trees and shrubs on pri-

The number of permits issued by the City Forester's office, since 1908, is as follows:

1908-1909	5,468
1909-1910	5,320
1910-1911	4,668
1911-1912	4,659
1912-1913	5,929

The increase in planting during the last year is attributed largely to the work done by the Forester's office in advising people to take advantage of favorable planting conditions and to the ordinance quoted above, allowing property owners to make a change in the selection of the tree species.

During the coming year the number of trees planted in the city ought to be many times that of preceding years. Those who are interested in the more detailed study of the planting of trees are referred to various text books on this subject, especially to a volume on "Shade Trees in Towns and Cities," by Wm. Solotaroff, and to the "Care of Trees," by B. E. Fernow.

FLORAL DISPLAY FOR APRIL AND MAY.

Cold and cloudy weather caused the flowering period of the Easter bulbs to be somewhat lengthened and during the first week of April the tulips, hyacinths, lilies and narcissi were the main attractions, while *Eupatorium ianthinum, Primula obconica, Primula veris* (the English primrose), *Primula kewensis,* spiraeas and *Euphorbia jacquinaefolia* were used to fill in the gaps left as the bulbs were taken out.

With the removal of the bulbs, the lilies excepted, the stages were filled with potted roses, while on the side benches clumps of the new French hybrid hydrangeas were displayed. The 500 roses exhibited comprised the finest of the hybrid perpetuals, the hybrid teas, and polyantha sorts. Some of the best of these are the following: Dean Hole (pink), red and white baby ramblers, Mad. Ravary (cream or flesh color), Killarney (pink and white), Blumenschmidt (yellow), Captain Christy (soft pink), Magna Charta (red), Etoile de France (dark red), Frau Karl Druschki (snow-white) and Farben Königin (red pink). The hydrangeas in colors of red, blue, pink and pure white are an improve-

ing or any other artificial conditions. This is without doubt the finest collection of exhibition hydrangeas ever shown in St. Louis.

Two flowering palms in the center of the first house, while not particularly showy, are of general interest because not usually seen in flower. These are *Chamaerops humilis,* the dwarf fan palm, and *Phoenix canariensis,* one of the date palms. An unnamed species of *Beschorneria,* belonging to the same family as the century plant, with tubular yellow green flowers, is also in bloom.

A number of dwarf potted fruit trees in flower, that have recently been imported from Europe, form part of the display. These include apples, cherries, pears, peaches, nectarines and grapes. Fruit has set on all of these little trees and when ripe the plants will again be placed on exhibition. The trees have been trained into pyramids, fan-shapes and gridirons and are attracting considerable attention.

The latter part of April and the early part of May there will be exhibited plants that for variety, at least, will surpass the Easter display. The roses and hydrangeas will continue to be shown as long as they last and the following plants now coming into flower will be added: 200 cineraria hybrids in red, white, blue and various combinations of these colors; 300 tobacco hybrids in red, purple, pink and white; 100 *Felesia amelloides* (the blue daisy), blue with yellow centers; 200 calceolaria hybrids in all combinations of color; 600 hybrid gloxinias mostly in solid colors; 200 *Nicotiana sylvestris,* a tobacco plant with small pure white flowers; 200 *Primula veris* (the English primrose); *Primula chinensis,* and quite a number of large marguerites *(Chrysanthemum frutescens).*

These will not all be shown at once, but will follow each other very closely and several visits to the Garden may be necessary to see all of them. However, the special attraction to be expected will be posted in the greenhouses for the convenience of those who are interested.

The foregoing are all being shown in the north wing of the new conservatories, but in the old greenhouses many rare and interesting plants are also in flower. The follow-

the butterfly orchid; *Selenipedium Ainsworthii,* the slipper orchid; *Chysis bractescens,* the wax orchid; the various other species of orchids, including *Epidendrum patens, Oncidium ampliatum, Oncidium sphaceolatum* and *Lockhartia pallida,* all in the orchid house.

Out of doors the main display for spring effect, as in years past, is the tulips. The parterre and adjacent ground has been planted with over 30,000 bulbs and during the blooming period will be a blaze of color. They will be at their best the last two weeks of April. The varieties particularly worth while are the following: Kaiser Kroon (red and yellow), Chrysolora (yellow), Cottage Maid (pink and white), La Reine (white), Yellow Prince (yellow), Belle Alliance (red), Cramoisie Brilliant (red), Pottebakker Scarlet (scarlet), Crimson King (crimson), Jusst von Vondel (dark red with white stripes), and Pottebakker White (white).

Just in front of the main entrance is an oval bed of narcissus containing over 1,200 clumps. This bed was made from bulbs transplanted this spring, an unusual proceeding, but made necessary by the improvements in other parts of the Garden where they were formerly growing. They are doing well and make a brilliant show of yellow color.

INTERNATIONAL FLOWER SHOW.

The International Flower Show, held in New York City at the New Grand Central Palace, April 5-12, was a decided success. It is estimated that a quarter of a million dollars worth of plants and blooms were exhibited, and certainly this country has seen no such single show of flowers. On the other hand, with the exception of a few collections of particularly fine plants or single specimens of rare or new forms, the indoor floral displays at the Missouri Botanical Garden throughout the twelve months far exceed in quantity, variety and quality the exhibition crowded into one week at New York. In spite of the various exhibitors from this country and abroad, of tulips, hyacinths and daffodils the display could not be compared with the Easter show at the Garden. None of the novelties which attracted so much

The prize of the Missouri Botanical Garden for the best new flowering plant was awarded to Adolph Lewisohn, Esq., Ardsley, N. Y., Mr. J. Canning, Gardener, for a particularly fine and striking jewel flower *(Impatiens)*. The size of the plant with its exceptionally large and abundant flowers and deep rich red color, marked it at once as being unusual and after a careful consideration by the judges it was unanimously given first prize.

The prize for the best new foliage plant was given to John Wannamaker, Esq., Mr. John Dodds, Superintendent, for a variegated pandanus. Although entries of economic plants were received from as far away as New Orleans, none of the specimens were considered as being up to the standard and no award was made.

NOTES.

About twenty-five members of the St. Louis Section of the American Pharmaceutical Association visited the Garden on March 18th. While not much could be seen in the outdoor medicinal garden because of the early season, the members found many plants of interest to the druggist in the plant houses.

Dr. George T. Moore, Director of the Garden, visited the International Flower Show, held in New York City at the New Grand Central Palace, April 5-12. In addition to seeing the exhibits in the interests of the Garden, Dr. Moore acted as judge in some of the sections.

On April 1, Carl Haltenhoff and Earl Reed each completed the four years' course as Garden Pupils and were granted diplomas after being examined by the Garden Committee of the Board of Trustees and the Director of the Garden.

Mr. A. R. Davis, Rufus J. Lackland Fellow in Botany in the Shaw School of Botany, will spend the summer in the Marine Biological Laboratory at Woods Hole, Mass., as assistant to Dr. B. M. Duggar.

Dr. Wm. Trelease, Professor elect of Botany in the University of Illinois, and former Director of the Missouri Botanical Garden, Dr. H. J. Webber, Director of the Graduate School of Agriculture at Riverside, California, Dr. Wilhelm Miller, Associate Professor of Horticulture in the College of Agriculture, University of Illinois, and Dr. George M. Reed, Professor of Botany at the University of Missouri, visited the Garden during March.

Thirty-five members of the McKinley High School class in Physical Geography visited the Garden for a study of the distribution of plants in connection with their work.

Dr. George R. Hill, Jr., Research Assistant, has accepted the Professorship of Botany in the Utah Agricultural College. Before entering upon his new duties, in September, Dr. Hill will teach plant physiology in the Cornell Summer School.

Dr. E. J. Durand, Assistant Professor of Botany at Missouri University, spent several days at the Garden consulting the mycological herbarium.

Dr. J. M. Greenman, Curator of the Herbarium, delivered a lecture before the Tuesday Club, on April 15th. The subject of Dr. Greenman's lecture was "Trees."

Dr. B. M. Duggar, Plant Physiologist to the Garden, addressed the St. Louis Academy of Science, on April 21st, on the subject of "The Significance of Color in Plants."

Contrary to the usual custom, the April 12th meeting of the Engelmann Botanical Club was held in the afternoon. A discussion of the cycads from three standpoints, by Dr. George R. Hill, Jr., Mr. George H. Pring, and Mr. J. R. Schramm, respectively, formed the program of the meeting together with an inspection of the Garden collection of cycads.

Mr. Slavin, of the Rochester, New York, Park Department, visited the Garden on his way to Texas, where he will do some collecting.

About one hundred and thirty-five students from the College of Pharmacy, in charge of Dr. Whelpley, visited the Garden on March 25th.

STATISTICAL INFORMATION FOR MARCH, 1913.

GARDEN ATTENDANCE:

Total number of visitors.....15,297

SEED EXCHANGE:

Total number of packets distributed..... 2,755
Total number of packets received..... 1,628

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought..... 26
Total number of books and pamphlets donated..... 94

HERBARIUM ACCESSIONS:

By Exchange—
N. Y. Botanical Garden—Utah plants..... 76

By Purchase—
Miss J. E. Tilden—South Pacific Island plants..... 300
E. Bartholomew—North American fungi..... 200
E. Gilg—African plants 155

By Gift—
H. von Schrenk—Louisiana plants 2
T. C. Brandegee—Mexican plant 1
C. R. Orcutt—Texas and Mexican plants..... 86
E. W. D. Holway—Mexican and Porto Rican fungi..... 3
Moses Craig—Missouri plants 12
W. H. Emig—Cultivated plant..... 1

Total..... 836

The Garden is open to the public Sundays from Easter Sunday to Nov. 30, 2:00 P. M. until sunset. Week-days the year 'round from 8:00 A. M. until one-half hour after sunset. Admission Free.

Personally conducted trip through Garden every Saturday afternoon from May 1 to Nov. 1, starting from the Main Gate at 3:00 P. M.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

STAFF
OF THE MISSOURI BOTANICAL GARDEN

Director,
GEORGE T. MOORE.

Assistant to the Director,
JACOB R. SCHRAMM.

BENJAMIN MINGE DUGGAR,
Plant Physiologist.

HERMANN VON SCHRENK,
Plant Pathologist, *Honorary.*

JESSE M. GREENMAN,
Curator of the Herbarium.

CHARLES H. THOMPSON,
Assistant Botanist.

GEORGE R. HILL,
Research Assistant.

CORA H. THOMPSON,
Curator of Library.

JAMES GURNEY,
Head Gardener, *Emeritus.*

WILLIAM W. OHLWEILER,
In General Charge of all Departments

CARL GARRETT,
In Charge of N. A. Tract and Rose Garden

HENRY MEIER,
In Charge of Main Garden

GEORGE PRING,
In Charge of Orchids and Exotics

MAX SCHILLER,
In Charge of New Plant Range

Missouri Botanical Garden Bulletin

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ST. LOUIS, MO.

BOARD OF TRUSTEES
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Missouri Botanical Garden Bulletin

Vol. I St. Louis, Mo., May, 1913 No. 5

GARDEN IMPROVEMENTS.

MAIN GARDEN.

The February number of the BULLETIN called attention to the large additions in the greenhouse equipment of the Garden. Their location, massiveness and importance have made necessary many changes in the treatment of the grounds in the vicinity. While the old greenhouses have been the keystone of the formal treatment maintained for so many years, the location of the new conservatories behind the wall and at right angles to the axis of the old houses made it essential that the Garden be so altered as to properly conform to both the old and the new houses. It is also evident that any formal arrangement must be made subservient to the buildings themselves and should in no way detract from their importance in the general scheme. The formal garden is now confined to a small area in front of the new range. South of what was formerly the parterre, a large area has been changed from a formal into a natural garden and, in a great measure, serves to bring into harmony the various elements entering into the present Garden plan.

It is the purpose of this BULLETIN to give in detail the object of all the important changes that have been made in the landscape of the Garden this spring and to briefly outline the principles governing the same. It is perhaps not generally known that the landscape gardener, in laying out work, is governed by rules of procedure just as much as any other artist, and that failure to properly take into consideration various elements results in an unnatural effect. It is hoped that the explanation here given will help to make the Garden more attractive and interesting to visitors this summer.

Walks.—No one thing is so essential in viewing the collections and greenhouses in a garden open to the public as easy

are ideal in every way. These are 18 inches deep, having one foot of 2-inch rock, four inches of ⅞-inch rock and two inches of screenings. Each layer was thoroughly rolled and subsequent rain and use have made them smooth and hard. These walks, in most cases, do not cover the same route as the old ones, which, with a number of the smaller walks, have been dug out and filled with soil. The major portion of the new walks are twelve feet wide, a few of the shorter connecting walks being eight feet in width. Beginning at the Flora Boulevard gate the main walk runs south to the Victory statue, thence west just north of the grove and again north in front of the new conservatories, turning east between the Linnean house and the old range and finally south to the main gate. In course of time this system of walks will be extended to connect all the important parts of the Garden.

Formal Gardens.—The area to be devoted to the formal gardens, while not less than in former years, will be concentrated near the conservatories. It will consist of two parts, one in front and one in the rear of the new greenhouses. The former, now being installed, occupies almost the same ground as the old parterre, or sunken garden, and is intended primarily as a water garden for the growing of lilies and other aquatic plants. The long axis of this garden lies east and west and its outline is rectangular. The corners of the pool are indicated by four large American hollies that formerly stood around the old observatory to the south. Just outside the walks, surrounding the water garden, are four large ginkgo, or maiden-hair trees, which were planted here this spring to increase the effectiveness of the formal design. At the ends of the pool a semicircular walk connects,on the one hand, the main gate and on the other the steps to the new conservatories. On each side of the pool, walks lead down to the edge of the water garden and furnish vantage points for the closer inspection of the water-lilies. The areas between the banks of the pool and the surrounding walks will be the only ones in the main garden this summer planted with formal designs of bedding plants. Reference to the accompanying plan will make all of these details clear.

Behind the main range and flanked by the two wings of the new conservatories will be located an elaborate formal garden, Italian in its general effect. Three exits from the new con-

vation was possible. It is probable that this garden will not be completed until time to do the planting for next spring's bulb-display.

The concentration of the formal areas into these two localities will add much to their effectiveness and will have the further advantage of harmonizing with the formality of the massive houses near them. The water garden while being strictly formal will have a softening influence that will not detract in any way from the greenhouses themselves.

Main Garden Proper.—The remodeling of the parterre was essentially a rearrangement of existing conditions, but in the part of the Garden between the mausoleum and the parterre nothing of the old arrangement remains to indicate where things formerly were. In place of the flat, hedge-covered plain, with its myriads of small beds and maze of walks, there is now a rolling landscape, covered with shrubbery and flowers, with long stretches of lawn broken by a small stream and its accompanying pools. The formality is gone and in its place appears a bit of natural landscape much more pleasing and restful than any formal garden could ever be.

Grading.—The area south of the formal garden, where most of the changes have been effected, was formerly an even slope from east to west with a decided dip to the north. The new walks constructed this spring nearly surround this part of the Garden, and, in order that everything need not be viewed across this area, an effort was made in grading to break up the landscape so as to frame in the view by small knolls, making the particular object to be seen appear at the end of a valley. In nature we generally look down the valley for our views, not across the hills, but with them. The landscape painter frames in his pictures with trees and shrubs, and the photographer makes an effort to properly balance his effect; so here in making a real picture an effort has been made to achieve the same result, it being necessary to take into account the added difficulty that, unlike the painter and the photographer, we have to deal with a highly complex and uneven surface.

Reference to the plan will show that this gently sloping hillside is now a series of small hills with the valleys converg-

in nature this bit of scenery would spread over miles of surface. Consequently, in order to thoroughly appreciate the views presented, one must be able to imagine the larger things that this miniature landscape represents.

Of course, in the actual construction, the valleys are the more important since they are a finished surface and any defects in them will be easily seen. These are all in grass and, as such, have received the careful treatment recommended for lawns in a previous number of the BULLETIN. The exact contour of the hills is not so essential because any defect in grade is soon covered up by the shrubbery, and, furthermore, the height can easily be increased or decreased by changing the plantations. The valleys, which are the main vistas, are indicated on the plan by the arrows along the main walk.

Plantations.—The plantations have been confined almost exclusively to the hills, in order to accentuate the effect desired. Merely obtaining a mass of green foliage, with large groups of flowering shrubs, would fall far short of making a pleasing plantation and, further, attention had to be paid to the natural habitat of the plants nsed. For instance, we expect to find willows along a stream or near a pool, not exposed to the full force of the winds and droughts of the hill tops. Owing to the lateness of the season, after the grading had been finished, it was not possible to properly arrange the shrubs and trees just as they will ultimately appear. Temporarily the different knolls have been planted simply to frame in the views and to provide the necessary background for the planting of flower masses. At the present time the knolls (see plan 2) are planted as follows: — Knoll 1 with hydrangeas, forsythia, mock orange; knoll 2 with spiraea, red bud, forsythia, phellodendron, weigelia, dog-wood, mock orange, aralia, and the white fringe; knoll 3 in lilacs; knoll 4 with various shrubs but designed eventually for large-flowering members of the mallow family like the "Rose of Sharon," etc.; knolls 5 and 6 in miscellaneous shrubs; knoll 7 is planted with the large-leaved caladiums or elephant ears, with a background of manihot and pokeweed; knoll 8 is planted solid with cannas, of which the Garden has an unusually fine collection. The little pools and the stream running down through this part of the Garden are planted with water plants of all sorts, and while these plantations are

lawns, visitors cannot be allowed to roam at will through this area the present summer, but in future years access to all parts of the Garden will be possible.

Along the knolls, borders of flowers have been planted, following the general outline of the shrubbery masses. No attempt has been made at fancy or carpet bedding, for these would be distinctly out of place against the otherwise natural landscape. For much the same reason foliage plants as such have not been used. Instead, it has been decided to provide large masses of color throughout the summer and to so group these that harmony will be preserved in any particular perspective. As one walks around the Garden there will be a constant change in the color scheme and even the effect in the same valley will vary when seen from different points. It is hoped that by the use of different plants each year the Garden will not present the same appearance two seasons in succession.

Views.—As one walks south from the main entrance several interesting views may be had. First, there is the little pool with the caladiums and the cannas massed behind it, and along its border many kinds of water plants. In the background is a portion of the stream that winds down from the rockery west of the grove. Further south and looking from between the purple beech and a large horse-chestnut is a splendid view of the new conservatories, perfectly framed in by green foliage on each side. The beauty of the scene is heightened by the pool of water lying in the foreground. As one proceeds there is a view of the Victory statue and the entrance to the grove where the mausoleum stands. From the walk around the Victory one can see the little pool at the end of the valley, while beyond are the old greenhouses.

From a point a little further along one gets sight of the old greenhouses, which this time seem to be in an almost formal setting, owing to the peculiar arrangement of the valley and the trees bordering it on each side. Continuing along the same path, various views of the stream and the pools, which are a part of it, appear and from the west side of the Garden one constantly gets little glimpses of the greenhouses, the main entrance, and other bits of the formal garden. These, however, do not form the important part of the vista, but are subservient to it. Since the first view of the new conservatory, it has been obscured, but now at a bend in

and looking south the whole landscape spreads out in front of one, for all of the valleys converge here, and the masses of shrubs, the flowers and the stream are all best seen at this point.

While the greater part of the effect desired will be evident during this season, the growth of the shrubs and trees with the flower masses will make a constantly changing landscape and it is expected that this picture will not lack proper variety from season to season.

Trees.—Much of the immediate effect produced this summer will be gained as the result of the mature appearance given by the many trees that were not in this part of the garden last year. Over thirty large trees were transplanted early this spring, being moved when frost was still in the ground. These were dug out with a large ball of earth still frozen around the roots. An ordinary stone boat, and a block and tackle, were the only necessary appliances. Each tree has been provided with guys to prevent wind shaking, as well as with drain tiles for watering, and thus far are in good condition.

Rockery.—The stream that is to run northeast through the new part of the Garden will have its source in a rockery in the southwest corner of the grove. The rockery, of course, will be artificial, but an attempt will be made to have it conform to natural lines. Reference to the plan will show that the general effect sought is a stream orginating from a rather large hill in the background and flowing out between two lesser hills in front. The slopes of these hills will be used for the growing of alpine flowers, ferns, and other rock-loving plants. Opportunity will also be provided for the visitor to go up into the small gorge and view at close range many of the plants growing along its sides. The rocks used in its construction are, for the most part, weather beaten granite boulders brought from the Ozarks. The water will tumble down through the gorge and out into a small pool just beyond, from which it begins its journey to the pond at the lower end of the Garden.

Succulent Garden.—In the northwest corner of the Garden between the main walk and the wall is a space to be used for the display of the succulent plants. For a number of years the Missouri Botanical Garden has been drawing from the

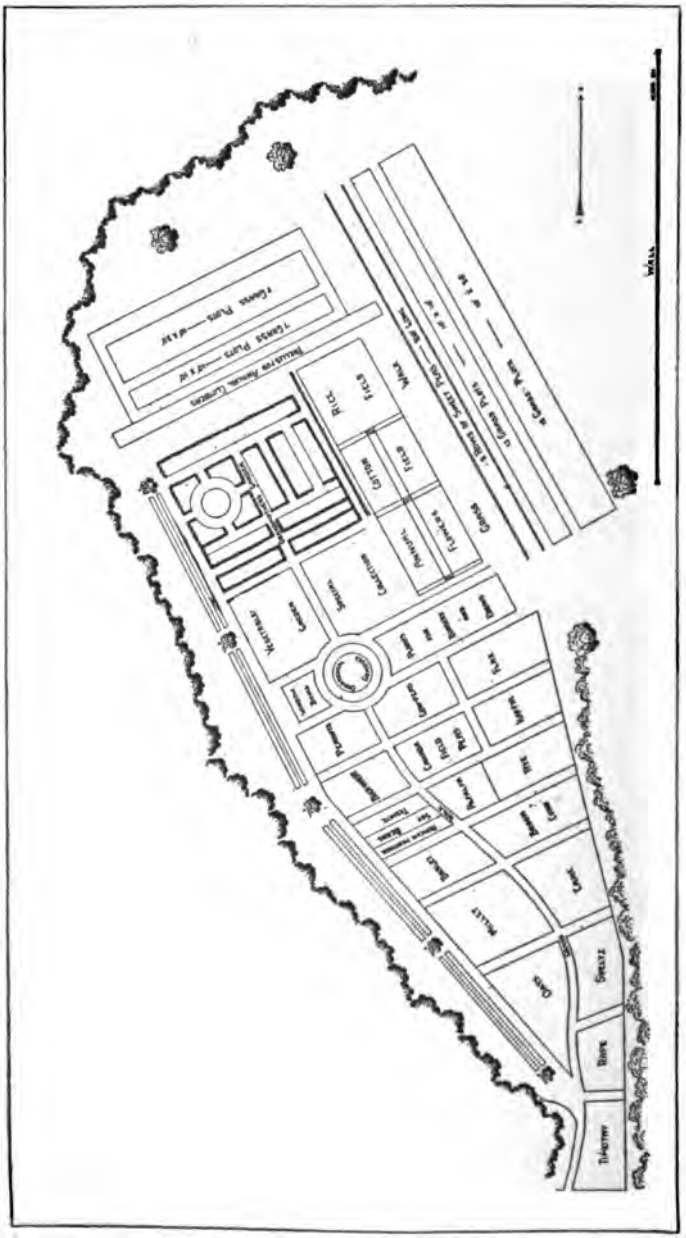
collection. The cylindrical and opuntia cactus forms will be put in a bed near the wall while the agaves, or century plants, will be placed in a large circular bed, with other cactus plants grouped around them.

English Garden.—West of the Linnean house and in the northeast corner of the Garden a section has been reserved for plants typical of an English garden. No attempt has been made to have it represent any particular plantation, although this will probably be done another year. It will be filled with such plants as hollyhocks, snap-dragons, sweet-williams, fox-gloves, stocks, pinks, cockscomb, etc.

The Old Wall.—Most of the old wall that formerly ran along the west side of the Garden has been removed so as to leave an unobstructed view to the greenhouses. The part bordered with figs has been left for their protection and the corner near the succulent garden has also been retained. Removing the wall has made a great change in the general appearance of the Garden, no one thing tending so much to apparently increase its size.

HERBACEOUS GROUNDS

This area, which for many years has been devoted entirely to a collection of species representing various botanical families, has been completely remodeled. As one enters the grounds from the north, a formal design of plants used for borders and edgings is seen. These are to be kept trimmed and in good condition and will serve to answer frequent queries as to what plants can best be used for this purpose. Beyond this is a round bed of ornamental grasses and immediately behind are a number of window boxes planted with various vines and flowers intended to furnish ideas for this popular style of planting. To the west is a plot of ground the size of an ordinary back yard, and on this area a succession of vegetables will be grown throughout the season, serving to show what can be done with such a patch. A chart will be posted showing the different plants raised, the amounts of seed sown, the crop produced, the time of planting and similar information. Just west of the vegetable garden an area about 100 feet square has been laid out to represent a "Grandmother's Garden." The hedges, walks, etc., give this the necessary formal appearance, but the



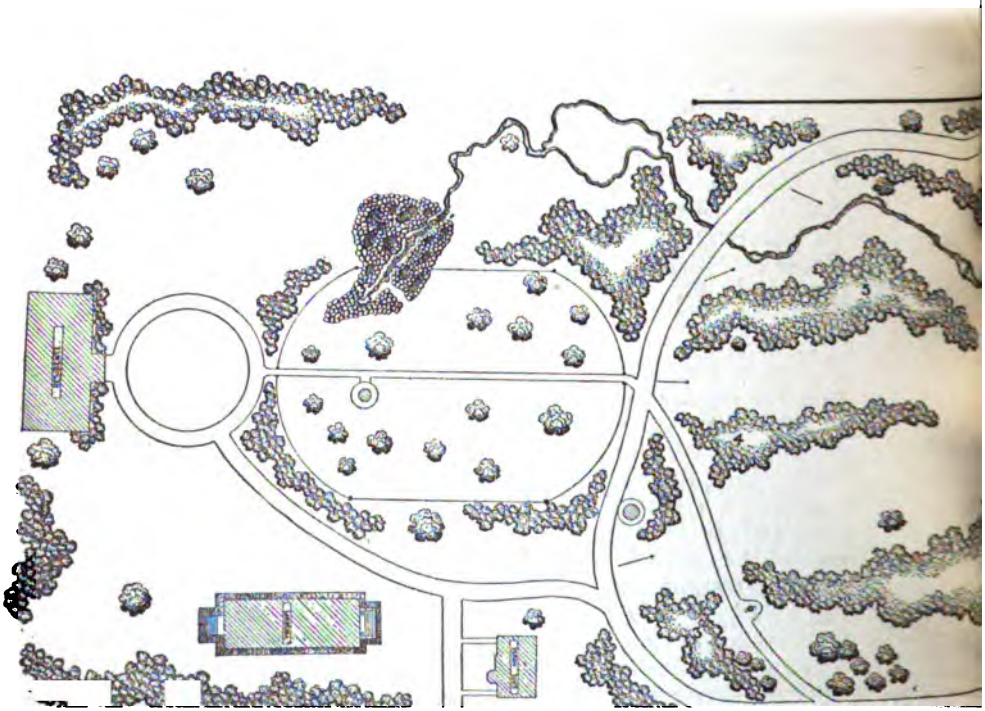
PLAN I.
HERBACEOUS GROUNDS

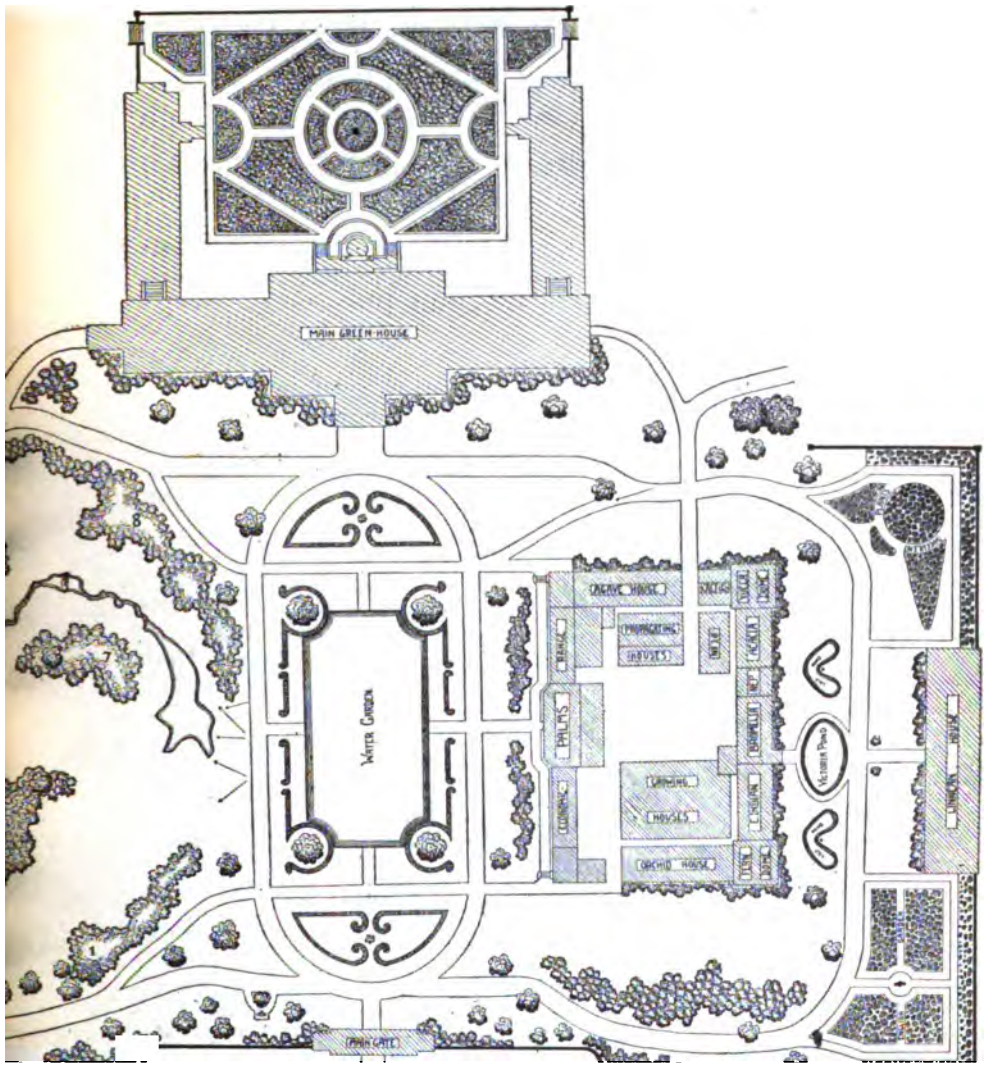
this year from seed. To the east of the formal design the whole area has been devoted to rather large plots of farm crops, including flax, cowpeas, peanuts, Kaffir corn, Canada field peas, buckwheat, rye, alfalfa, barley, broom corn, sugar-cane, millet, speltz, oats, rape and timothy. On the north side, and separated from the rest of this area by a grass walk, are two long rows of sweet peas growing on trellises. These include a collection of some of the best of the hybrid varieties and when in bloom ought to produce a splendid lot of color.

On the extreme north and west sides of the grounds are a double row of grass plots. These will be used as experimental lawn plots for the testing of different grasses, alone and in various combinations. The mixtures will be especially chosen to suit various conditions such as dry and wet soils, sandy and clay soils, terraces and slopes, sunny and shady places, etc., and the necessary information will be posted on each plot. There are twenty beds in all and the treatment of the soil for all, as regards plowing, manuring and liming, was just the same. Along the south side of the grounds and broken by several Lombardy poplars is reserved a space for the growing of hardy climbers to be planted later. However, just west of the "Grandmother's Garden" and on another trellis has been planted a collection of annual climbers which will be of more than passing interest. There is also a small area given up to plants for special uses, as savory and medicinal herbs, hardy perennials for private place planting, etc.

ROSE GARDEN

West of the main office building a plot of ground formerly used for vegetables has been set aside as a rose garden. This is somewhat cut off from the main part of the Garden by the old residence and when first seen it is more or less of a surprise. Along the southern edge is a large pergola situated upon a sufficient elevation to afford a view of all the roses. The design of the garden is purely formal, more so than any other part of the grounds at present, being mainly a series of circles cut by straight and curved walks. It is entered from the east side by a walk lined with a double row of standard Lady Gay roses and bordered by Orleans and Katherine Zeimet. The pergola itself will have growing upon it the following unique collection of climbers: Kalmia, Paradise, Debutante, Minnehaha, Hiawatha, Lady Gay, La Fiamma, and Maid




MAIN GREEN HOUSE
WATER GARDEN
AGAVE HOUSE
PROPAGATING HOUSES
RANGE
PALMS
CLOAKING
GRAVING HOUSES
ORCHID HOUSE
ACACIA
BARIMELLA
CINDIAN
VICTORIA POND
LINNEAN HOUSE
MAIN GATE

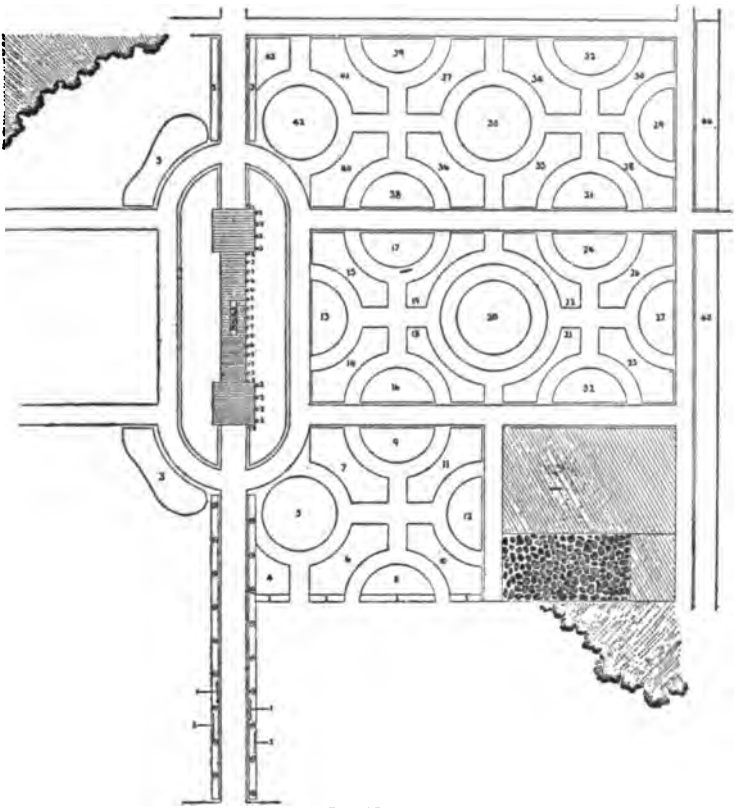
+ Lady Gay standards

1. Orleans.
2. Katherine Zeimet
3. Atropurpurea, Belle Poitevine, Blanc Double de Coubert and Conrad F. Meyer.
4. Maman Cochet, white, Perle von Godesberg, Wellesley, Col. Le Clerc.
5. Farben Königin.
6. Mlle. Marie Van Houtte, Souvenir de Pierre Notting, Mrs. John Laing, Mad. Gabriel Luizet, Kaiser Friedrich, and Safrano.
7. Mad. Segond Weber, Edu. Meyer, Kaiserin Augusta Victoria, Apotheker Georg Hofer, Indiana, Richmond, Mrs. Stewart Clark, Freiherr von Marschall, Blumenschmidt.
8. Maman Cochet, white.
9. Maman Cochet, white.
10. J. B. Clark, Ruhm der Gartenwelt, Magna Charta, Ulrich Brunner, Gustave Regis, Mildred Grant, Hugh Dickson and Isabella Sprunt.
11. Duke of Teck, Philemon Cochet, Mrs. R. G. Sharman-Crawford, Frau Karl Druschki, Augustine Guinoisseau, and Margaret Dickson.
12. Mrs. Aaron Ward.
13. Killarney Pink.
14. Harry Kirk, Mrs. Theodore Roosevelt, Belle Siebrecht, Prince of Bulgaria, and Mad. Caroline Testout.
15. Souv. du Pres. Carnot, Mad. Jenny Guillemot, Mad. Joseph Combet, Reine Marguerite d'Italie, Königin Emma, and Helen Gould.
16. Liberty.
17. Gruss an Teplitz.
18. Rosalind Orr, English, Queen of Spain, Rhea Reid, Otto Von Bismarck, Jonkherr J. L. Mock.
19. Perle von Godesberg, Mad. Edmee Metz, Lyon Rose, Bessie Brown and William Shean.
20. Etoile de France and General McArthur.
21. Oberbürgermeister Dr. Troendlin, Grace Darling, Gustave Grunerwald, La France, La Tosca, Apotheker Georg Hofer, Betty and Duchess of Wellington.
22. Mad. Ravary, Wm. R. Smith, Chateau de Clos Vougeot, Laurent Carle, La Detroit, Arthur R. Goodwin, My Maryland and Souv. du Pres. Carnot.
23. Mad. Jules Grolez.
24. Maman Cochet.

26. Königin Wilhelmina, Pharisaer, Francisca Kruger, Mad. Constant Soupert, Duke of Edinburgh, Lady Roberts and Captain Hayward.

27. Kaiserin Augusta Victoria.

28. Rodhatte, Friedrichsruh, Countesse of Gosford, Mrs. B. R. Cant, Sunrise, Marie Guilot, Mrs. Aaron Ward, Otto Von Bismarck, Maman Cochet, Yellow and White Killarney.



PLAN 3.
ROSE GARDEN

29. Mrs. James Gray.

30. White Killarney, Ecarlate, Miss Cynthia Forde

31. Otto Von Bismarck.

32. Mrs. B. R. Cant.

33. Marshall Field, Ecarlata, Mme. Maurice de Luze, Mad. Jules Grolez, Lady Pirrie, Nathalie Bottner, Mrs. W. G. Miller, Marichu Zayas, Grace Molyneaux, Lady Helen Stewart, Mrs. James Gray, George C. Waud, Mrs. Foley-Hobbs, Countess of Gosford, Gen. McArthur and Countess of Shaftesbury.

34. Souv. de la Malmaison, Helen Gould, Entente Cordiale, His Majesty, Mrs. A. R. Waddell, Duchess d'Ossuna, Radiance, Dean Hole, Farben Königin, White Killarney, Le Progress, Marquis de Sinety, Etoile de France, Mad. Jules Grolez, Kronprinzessin Cecilie and Col. R. S. Williamson.

35. George C. Waud and Reine Marguerite d'Italie.

36. Frau Emma Sasse, Lady Alice Stanley, Mad. Jules Gravereaux, Countess of Gosford, White Killarney, Celine Forestier, Maman Cochet Pink and Augustine Guinoisseau.

37. Souv. de la Malmaison, Dr. O'Donel Browne, Admiral Dewey, Gartendirektor Hartrath, Zephyrine Drouhin, Alfred K. Williams, Mad. Isaac Pereire, Clio, Tom Wood and Beaute de Lyon.

38. Lady Ashton.

39. Walter Speed, Grace Molyneaux, Mlle. Helen Gambriel.

40. Mad. Chas. Wood, Triumphe de Pernet Pere, Duchess of Brabant and Duchess of Albany.

41. Francisca Kruger, Coquette des Blanches, Baby Rambler and La Detroit.

42. Mrs. David McKee and Rayon d'Or.

43. Green Rose, Clothilde Soupert, Gruss an Teplitz.

44 and 45. Clothilde Soupert, Gruss an Teplitz, Flower of Fairfield, Climbing Baby Rambler, Tausendschön, Crimson Rambler and Dorothy Perkins.

The roses will be at their best during June, although it will, of course, require several years for the plants to attain their maximum beauty.

FLORAL DISPLAY FOR APRIL AND MAY.

New Greenhouses.—The display of flowers in the new con-

ing a few blue and white ones with pink and dark red varieties in some abundance, are at their best at present. Particularly attractive are the large-flowered tuberous begonias, which will continue to bloom for some time. The wonderful variety of colors and the large size of the flowers makes this display one of the most beautiful that has been shown this season.

The hybrid varieties of tobacco (*Nicotiana Sanderae*) are massed in great numbers on the side stages in the first section of the large show house, their variations affording a good example of the work of the hybridist. Large specimens of the marguerite (*Chrysanthemum frutescens*) are in bloom and occupy nearly all of the center of the house, while the latest introduction, "Mrs. F. Sander," a double variety and a great improvement on the old type, is exhibited on one of the side benches. The South African Caffer lily (*Clivia Mimiata*), with its large heads of salmon-pink flowers, is also to be found on the side stage.

In the center of the house is an interesting climbing lily (*Gloriose Rothschildianum*) with scarlet flowers, as well as an imported cherry tree in fruit, this being one of those exhibited some time ago in flower. During the latter part of the month the houses will contain a large collection of fuchsias. These include "Charles Black" with dark pink and blue flowers and *Fuchsia Speciosa* with light and dark pink flowers. There is also being shown the Natal lily (*Albuca Nelsoni*), the South African blue daisy and a great variety of foliage plants.

Old Greenhouses.—Among the tropical fruits now to be seen are the Brazilian cherry *(Eugenia sp.)*, having light yellow fruits, and the Barbados cherry *(Eugenia Uniflora)*, with small white flowers. On the west side of the front house, the red banana tree (*Musa sapientum rubrum*) is producing clusters of large red fruits. In the succulent house several varieties of the aloes are flowering, their long pendent spikes producing pink and white tubular blossoms. In the cactus house the climbing cactus (*Pereskia Bleo*) is covered with large heads of mauve flowers. Noteworthy features in this house are the bright scarlet flowers of the two grafted cactus plants of *Epiphyllum Russellianum*, one being grafted

chlora, with large white tubular flowers, and several species of *Mammillaria.*

The old orchid house has been filled with tropical ferns, including the golden fern (*Gymnogramme chrysophila*), the silver fern (*Gymnogramme tatarea*), the variegated fern (*Pteris argyraea*), the chain fern (*Woodwardia radicans*), the flowering fern (*Anemia phyllitides*), the oak-leaf fern (*Polypodium quercifolium*), and a collection of various forms of the maiden hair ferns (*Adiantum*). At the east end of the house are the insectivorous, or fly-catching plants, among which are the Venus Fly Trap (*Dionaea muscipula*), at present in flower, a plant which has sensitive hairs on the inside of the leaf which, when touched, cause the two halves to spring together, and the sun dews (*Drosera capensis*) and (*Drosera rotundifolia*), which will be in flower shortly and which have their leaves covered with glandular digestive hairs. The African glory vine (*Clerodendron Thomsonae*), growing above the entrance to the East Indian house, is in full bloom. Its petals are bright scarlet, with sepals pure white, later turning to a pinkish color. In the East Indian house a small group of the East Indian ixora (*Ixora coccinea*), with flowers produced in heads of a brilliant salmon color, is attracting considerable attention. Several of the spathe flowers are in full bloom, including the white spathe flower (*Spathiphyllum Wallisii*), the yellow flowered one (*Spathiphyllum cochlearispathum*), and the pink spathe flower (*Anthurium Regnaldsianum*).

The old cycad house south of the fern dome has been rearranged for the cultivation of the orchids. The most interesting species in flower at the present time is the cow-horn orchid (*Schomburgkia Tibicinus*), the pseudobulbs of which are hollow and shaped like the horns of a cow. Certain species of stinging ants of South America find a permanent home here, entering through a small opening at the base of the pseudobulb. The small black ants that inhabit the greenhouses have been noticed to enter these openings, but probably only out of curiosity, since they do not remain any length of time. This species is one of the best of the myrmecophilus orchids, the small mauve flowers borne on the end of long spikes being well worth noticing. A large plant of *Oncidium sphacelatum,* with long pendant spikes of yellow and brown flowers, is in full bloom and

large mauve-flowered orchid (*Cattleya mossiae*), the fringe lip orchid "Mme. C. Maron" (*Brasso-Cattleya*), a bigeneric hybrid, and *Dendrobium macrophyllum,* the large flowered variety. The "Star of Bethlehem" (*Angraecum sesquipedale*) will be in flower about the first of June.

NOTES.

In the Garden on the afternoon of May 2nd, a reception was tendered Mr. and Mrs. Andrew Carnegie and the out-of-town delegates to the Fourth International Peace Congress by the local Committees. The reception was held in a tent directly in front of the new plant range. The special floral exhibit arranged for the occasion attracted much attention and was visited and enjoyed by many of the delegates. Following the reception the delegates and guests were escorted to the broad, shady lawns near the administration building where an informal garden party was held.

Near the large lake in the North American Tract a new 20-room martin house has been erected. In addition, numerous boxes have been placed about the Garden for the bluebirds and wrens. Next to the plants, the birds are, perhaps, the most interesting feature of the Garden and everything is being done to encourage them to make their homes there.

The library training class of the St. Louis Public Library visited the Garden on May 6th to study the classification of a special library.

The May meeting of the Engelmann Botanical Club was held in the Graduate Lecture Room on the afternoon of May 10th. The classification and culture of members of the family Amyrillidaceae were presented respectively by Mr. C. H. Thompson and Mr. Max Schiller.

Dr. George T. Moore, Director of the Garden, addressed the St. Louis Academy of Science on Monday evening, May 19th, on the subject "Speculations on the Origin of Life".

A party of 200 ladies, wives of delegates to the Air Brakes Association of the United States and Canada, visited the Garden on May 6th and were conducted through the grounds [illegible] Botanist, Mr. C. H. Thompson.

of the University of Missouri on "Physiological Significance and Heredity of Color in Plants."

Material additions to the laboratories have been made in the last few weeks in the way of special work tables for physiological-chemical investigations.

STATISTICAL INFORMATION FOR APRIL, 1913.

Garden Attendance:

Total number of visitors	32,272

Seed Exchange:

Total number of packets distributed	2,755
Total number of packets received	1,846

Library Accessions:

Total number of books and pamphlets bought	48
Total number of books and pamphlets donated	187

Herbarium Accessions:

By Exchange—

Arnold Arboretum—Texas plants	3
Philip Dowell—North American plants	393
S. S. Visher—South Dakota plants	330

By Purchase—

H. Sydow—"Fungi exotici exsiccati"	100
E. Gilg—Kamerun plants	111
W. E. Broadway—Tobaga (W. I.) plants	101
W. Krieger—"Fungi saxonici, fasc. XLV"	50
T. S. Brandegee—Mexican plants, collected by C. A. Purpus	356
B. F. Bush—Missouri, Minnesota, and Illinois plants	521

By Gift—

Caroline C Haynes—North American Hepaticæ	20
G. H. Pring—Cultivated plants	30
C. O. Rosendahl—Photographs of *Nitella*	21
B. F. Bush—Missouri plan[illegible]	88
B. M. Dugg[illegible]	[illegible]
Univer[illegible]	

The Garden is open to the public Sundays until Nov. 30th, from 2:00 P. M. until sunset. Week-days the year 'round from 8:00 A. M. until one-half hour after sunset. Admission Free.

Personally conducted trip through Garden every Saturday afternoon from May 1 to Nov. 1, starting from Main Gate at 3:00 P. M.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

☞ On Decoration Day the Garden will be open from 8:00 A. M. until one-half hour after sunset.

STAFF
OF THE MISSOURI BOTANICAL GARDEN

Director,
GEORGE T. MOORE.

Assistant to the Director,
JACOB R. SCHRAMM.

BENJAMIN MINGE DUGGAR,
Plant Physiologist.

HERMANN VON SCHRENK,
Plant Pathologist, *Honorary.*

JESSE M. GREENMAN,
Curator of the Herbarium.

CHARLES H. THOMPSON,
Assistant Botanist.

GEORGE R. HILL,
Research Assistant.

CORA H. THOMPSON,
Curator of Library.

JAMES GURNEY,
Head Gardener, *Emeritus.*

WILLIAM W. OHLWEILER,
General Manager.

CARL GARRETT,
In Charge of N. A. Tract and Rose Garden

HENRY MEIER,
In Charge of Main Garden

GEORGE PRING,
In Charge of Orchids and Exotics

MAX SCHILLER,
In Charge of New Plant Range

Missouri Botanical Garden Bulletin

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ST.

PUBLISHED MONTH

BOARD OF TRUSTEES
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Missouri Botanical Garden Bulletin

Vol. I St. Louis, Mo., June, 1913 No. 6

THE YUCCA AND THE YUCCA MOTH.

From about the middle of June to the middle of July is the period of blossoming for most of the hardy Yuccas at the Missouri Botanical Garden.

As the visitor enters the main gate he will see a number of these plants growing in clusters about the recently constructed lily pond, between the main gate and the new greenhouse. Other isolated groups are to be found scattered throughout the grounds. The plants are natives of the southern Atlantic coast region of the United States and are cultivated extensively throughout this country and, to a less degree, also in the gardens of Europe; so they are not unfamiliar objects to most flower lovers. Nevertheless they always command admiration during their comparatively short period of flowering. Being evergreens, the bunches of long, sword-like, narrow, green leaves, springing as it were directly from the ground, constantly lend a bit of life and color to a garden even during the winter months. Some of these plants have rather stiff, straight leaves, while others are more lax and recurve in graceful form. All have a sharp point, and this, with the shape of the leaf, has given the plant the common name of "Spanish Dagger." Some have, in addition, numerous fine threads on the margins of the leaves and this form has been fancifully designated "Adam's Needle and Thread."

It is during the flowering period, however, that the plant shows to its very best advantage. At this time, in addition to the foliage characters just mentioned, it sends up a tall stalk from the center of the cluster of leaves, the upper half of which is branched and spreading. Scattered along an

shaped and nearly white—having a tint of green and sometimes of purple on the outside. A great number of these flowers, throughout the panicle, are open at the same time. As old ones wither, new ones open to take their places, thus presenting a full and beautiful display throughout the flowering period. During the day the new flowers are only very slightly opened; the floral parts being incurved into a more or less spherical body about one and one-half inches in diameter. However, toward evening, they expand into broad bell-form, exposing the white inner surface as well as the stamens and pistil. So it is at twilight that the plant appears in its greatest glory, and it is at this time, too, that the flowers give off their sweet, delicate perfume. The flowers remain open all night, but close up by sunlight, never to open again.

There are a considerable number of species of Yucca in the Garden collection; a few of which are from the western plains, being hardy and blossoming early; the majority are natives of warmer regions, however, and must necessarily be housed during our cold season. These are later in their various periods of flowering. Of the hardy western species there are several plants in different parts of the Garden. The largest and oldest of these is a splendid cluster near the center of the main garden. This was planted by Mr. Shaw, in 1860, in memory of his very near friend and medical advisor, Dr. Charles A. Pope, formerly one of the leading physicians of St. Louis. This plant, *Yucca angustifolia,* is reported to be the first one of the species introduced into cultivation.

It is not intended to imply that Yuccas are strong competitors for honor in a floral display, but the aim is rather to direct the attention of visitors to interesting phenomena in connection with the life history of these plants, namely a study of the interrelations between the Yuccas and certain insects—how each is entirely dependent on the other for its existence; how if the plants should all perish the insects likewise would soon die, and if the insects should by some means become extinct, it must inevitably follow that

the Yucca and its associated insect was Dr. George Engelmann, fittingly styled the pioneer botanist of the West, a resident of St. Louis and with whom the early history and foundation of the Missouri Botanical Garden is so closely associated. Dr. Engelmann's interest in the Yuccas began over fifty years ago, a time when but four species were generally recognized. Explorers of the West and Southwest sent or brought to him many specimens of the genus—their leaves, flowers and fruits. These, however, did not clearly harmonize with such knowledge of the group as had previously been obtained and the greatest confusion existed as to the plants. The largest herbaria were notably poor in material, especially of fruits and seeds. Dr. Engelmann, in his studies and explorations in Europe, was struck with the fact that Yuccas rarely ever fruited in that country. He already knew that specimens and reports from collectors on the Atlantic coast and the western plains, where various species were indigenous, showed that both fruits and ripe seeds were produced abundantly. The scientist's question, why? appealed to him and he set about to solve the problem. From his knowledge of the processes of pollination he suspected this work was carried on by some insect native to the habitat of the Yuccas, but as yet not introduced into Europe with the plants. Careful observations on the flowers of Yuccas growing beneath the window at his St. Louis home were soon rewarded with success. All circumstantial evidence pointed to a tiny white moth as the object of his search; a conclusion further substantiated by the discovery of the moth in the flowers of Yuccas growing in other and more remote parts of the city. Since Dr. Engelmann was a botanist, he was interested chiefly in the plant side of the subject and at this point he turned the investigation of the insect over to Dr. C. V. Riley, then the State Entomologist of Missouri. Together they observed and worked till the beautiful story of two life-histories was disclosed—one, of the plant; the other, of the insect. Dr. Riley's studies revealed to him that the moth was so highly specialized, more noticeable in the mouth parts and the egg-laying device, as to be entirely different and distinct from any other moth of its near kindred that had previously been described. Thereupon he gave to it the technical name of *Pronuba yuccasella,* the "Yucca Pronuba," or "Pronuba Moth."

commonly visit flowers. However, if the partially closed flowers are examined during the day many of them will disclose the hiding place of a tiny white moth, or "miller," scarcely more than half an inch long. It folds its wings together in roof-form over its back and rests lengthwise along one of the stamens. The whiteness of the insect blending with the white-walled floral chamber, all in diffused light, gives it ample protection and indeed one must frequently be very diligent in his examination to be able to see it at all. As dusk comes on and the flowers begin to open and give off their fragrance, the moths become very active, flitting about from flower to flower and from plant to plant. If, with a small "flashlight" or "bull's-eye" lantern, one takes a position by a plant he will probably be able to see the moth climb one of the stamens and with its specially constructed mouth parts, scrape all the pollen from the anther and roll it into a small pellet. This is then carried to a second stamen and the pollen from it is added to the pellet—the process being repeated from stamen to stamen until a good-sized ball is formed. Then the insect changes its scene of operation. Leaving the stamen, it goes to the pistil, which it explores very carefully, running around it and from top to bottom. When satisfied with the locality, it turns about till its head is toward the stigmatic, or upper end of the pistil, then it slowly backs downward between two stamens, feeling the surface of the ovary very carefully with the tip of its abdomen. When a suitable location is found, usually just below the middle of the pistil, it stops the body movement and begins to drill with its ovipositor, or egg-depositing device. This is long and sharp-pointed, especially adapted for drilling a small, deep hole into the heart of the pistil, where a single long, thread-like, transparent egg is deposited. As soon as this is accomplished the moth removes the ovipositor and then proceeds up the pistil until its head reaches the stigma. The stigma of the Yucca is a triangular well or tube formed by the union of the three upright horn-shaped processes of the ovary. Securing a firm foothold on these processes, the moth proceeds to shave off particles of the pollen pellet and with its tongue places these in the stigmatic well or cavity, forcing them far down. This done, it backs down the pistil and deposits another egg as before, but at a different point, and again going to the stigma it repeats the process of scraping off pollen from its pellet and forcing the particles down the cavity. This may be repeated until the stigma well is entirely filled. Frequently, however, the moth

removes to another blossom and repeats the interesting performance. Each flower is in condition to be fertilized only during a brief period of time, since after the first evening the hornlike processes of the pistil close over the stigmatic chamber and thus preclude the possibility of further pollination. In the course of about a week the egg hatches and the resulting larva feeds on the developing ovules which constitute its only food. When it has reached a mature size it burrows a passage to the exterior of the capsule and falls, or lets itself down by a silk thread, to the ground. Here it bores several inches below the surface and forms a tough silken cocoon intermixed with soil. It remains as a larva, or grub, within its cocoon during the fall, winter and spring months and transforms to the pupa or chrysalis state only a few days before emerging as an adult moth when the Yuccas bloom again in June.

It has been found that the Yucca flower is incapable of fertilizing itself; moreover, it is impossible for the wind to carry pollen from one plant to another. Extensive observations by many scientists in different parts of the country, since the early discoveries by Drs. Engelmann and Riley, prove that no other insect does this work which is so absolutely necessary to the production of seed. The amount of pollen placed in the stigma chamber by the Pronuba moth is sufficient to fertilize all the numerous ovules of that flower, while each larva hatched from the eggs deposited eats but comparatively few ovules—only ten or a dozen—thus allowing a vast majority of them to mature. Were it not for the intervention of the moth the Yucca plant could never reproduce itself except by offshoots or an accidental division of the parent plant. The plant depends entirely on the little moth to aid it in the natural method of reproduction. On the other hand, this moth does not associate with the flowers and fruits of any other plant than the Yucca. It feeds during its larval or "worm" stage only and then wholly upon the seeds of Yucca developing within the fruit on the plant. Should the adult moth deposit its eggs in the ovary and then fly away, the eggs would hatch, but the young larvae would soon perish from lack of food. To meet this demand the moth has developed a form of instinct which impels it to place pollen in the stigma of each pistil in which it has deposited an egg, insuring by this means the fertilization of the ovules and consequently a liberal supply of food for its offspring. Thus the insect is wholly dependent on the Yucca for its existence. Through

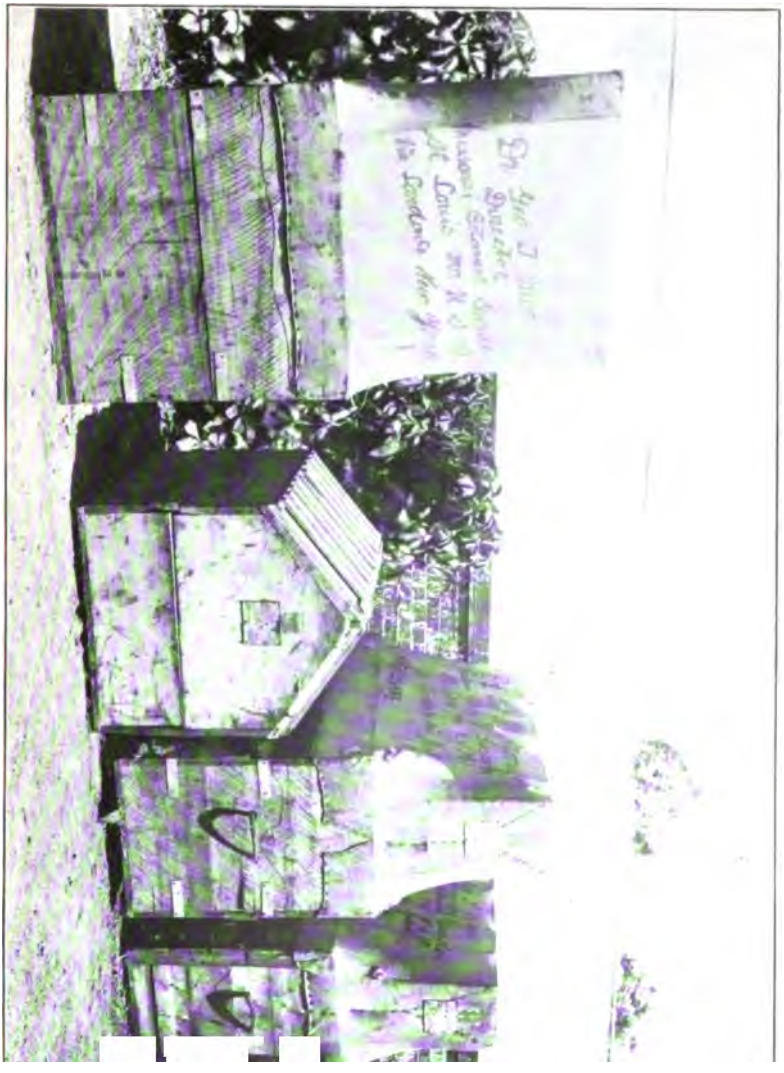
ages of association the plant has become adapted to such a degree that it cannot be pollinated by any other means in nature and at the same time the insect has become so adapted that it cannot carry on its life history with any other plant. To quote from one authority: "The insect offers such a remarkable instance of special modification of parts to a particular end, and there is such a striking interdependence between it and its food-plant that Hermann Mueller, who from his extensive studies of the relations between plants and insects, is most competent to speak on the subject, avowed it to be the 'most wonderful instance of mutual adaptation' yet detected." These are in brief the facts that have been brought to light and may be observed by anyone who will take the time and have the patience to watch the snowy little insects on any clear, warm evening.

It is of especial interest to know that many of the original observations, both of Dr. Engelmann and Dr. Riley, were made at the Missouri Botanical Garden through the kindness and encouragement of its founder, Mr. Shaw.

PLANTS FROM AUSTRALIA.

A collection of plants just received from Australia is of more than usual interest. This includes four *Macrozamia Moorei,* two male and two female; two *Cycas media,* one male and one female; two *Macrozamia spiralis* (possibly *M. Miquelii*), one male and one female; six large, six medium, and twenty-four small plants of *Bowenia serrulata;* all of which were secured from the vicinity of Rockhampton, through the kindness of Professor R. Simmons, Curator of the Botanic Garden, Rockhampton, Queensland, Australia. The shipment was three months on the way, but the plants were so well packed (see plate 12) that they not only suffered no injury but in some cases continued to grow.

These plants belong to the family Cycadaceae, of which *Cycas revoluta,* the so-called "funeral," or "sago palm," is the best known example. Perhaps the most interesting of the lot received is *Macrozamia Moorei,* a plant which is rarely found in botanical gardens and is rapidly being exterminated in the field because of a poison contained in the leaves, causing a paralysis of [illegible]



SHOWING METHOD OF PACKING PLANTS SHIPPED FROM AUSTRALIA.

Macrozamia Moorei grows from ten to twenty feet in height and may be over two feet in diameter. A splendid crown of leaves is produced, sometimes exceeding one hundred. The male and female cones are striking features of the plant, on account of their size and the unusual number which may be produced at one time. One hundred and three male cones in a single unbranched plant have been counted.

The particular point of interest, at least botanically, about *Macrozamia Moorei* is that it represents the nearest approach to the Bennettiales, a group of fossil, cycad-like plants existing in the mesozoic era. Never before has a living cycad been found which, because of its numerous lateral cones and their mode of occurrence, came so near to the conditions obtaining in these fossil forms, and it may truly be said that *Macrozamia Moorei* is the missing link so far as this particular group is concerned.

NOTES.

Prof. Bernard Mackensen of San Antonio, Texas, visited the Garden on the 13th of June.

Mr. Melvin C. Merrill, of Harvard University, has been appointed Research Assistant to succeed Dr. George R. Hill, Jr., resigned.

The annual flower sermon, provided for in Mr. Shaw's will, was preached at Christ Church Cathedral, Sunday morning, May 18th, by the Rev. Francis L. Palmer of Stillwater, Minnesota.

By special appointment, pupils from the McKinley High School visited the Garden on May 20th and ladies of the State Press Association on May 22d were shown through the greenhouses and grounds.

A wheeled chair has been placed in the waiting room at the main gate, where it will be available for those who are unable to walk through the grounds. The chair may be obtained upon application to the gatekeeper.

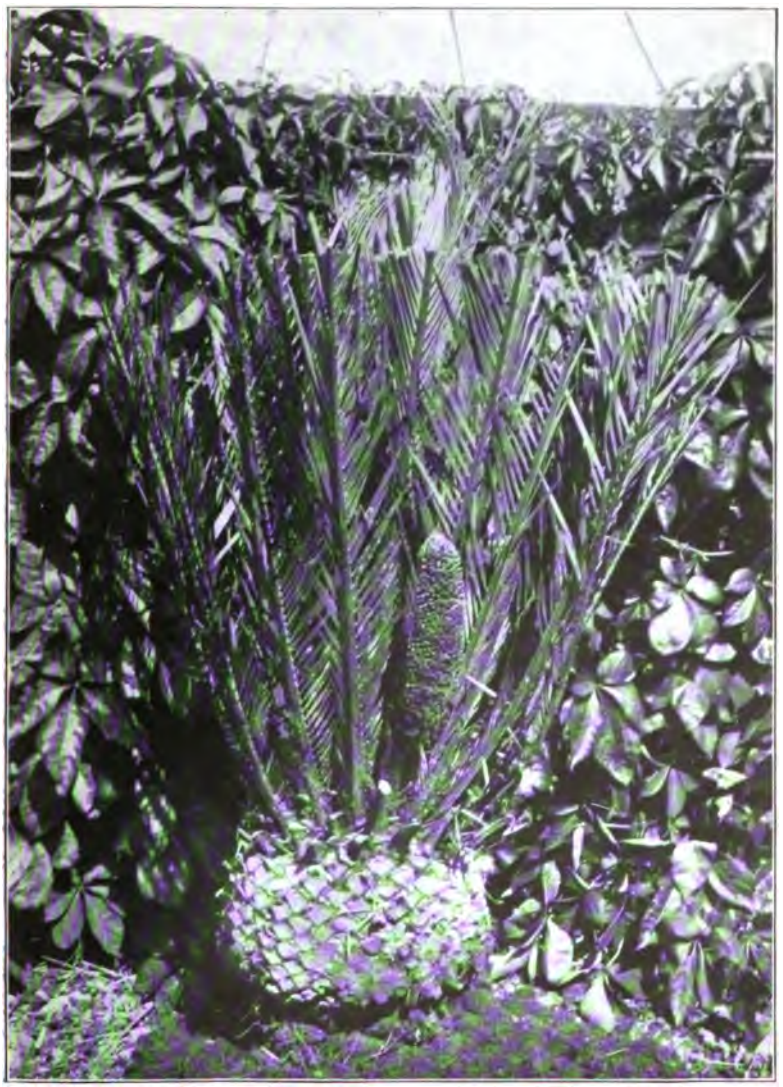
Mr. J. S. Cooley, Rufus J. Lackland Fellow, will spend part of the summer at the University of Wisconsin doing some special pathological work with Professor Jones. Mr. W. H. Emig, Rufus J. Lackland Fellow, will collect and study the mosses and hepatics in the Ozarks of Missouri and Northern Arkansas during the summer. Mr. L. O. Overholts will spend his vacation at Tolland, Colorado, where he will pay particular attention to the fleshy fungi of the local flora.

The June meeting of the St. Louis Florists' Club was held in the Graduate Lecture Room of the Garden on the afternoon of June 12th. About fifty members were present. After the business session a trip was taken through the grounds, especial interest being manifested in the new range of houses and heating plant, the model gardens, window boxes and rose garden.

The economic plants, which have been in the old range all winter, have been set out of doors to the east, west and north of the old houses, immediately against them. On the west and for a short distance on the north the plants are classified in groups as follows: Tropical fruits, oils, resins and gums, perfumes, condiments, medicinal plants and fibre plants. The rest of the beds are composed of a miscellaneous collection of specimens of some commercial importance.

The new range of greenhouses is practically completed. However, owing to the large amount of earth which is to be put in preliminary to the planting, and the confusion which must exist until the arrangement of the plants is completed, it has been necessary to close these houses to the public. The front part of the old range will likewise be closed for several weeks.

The last meeting of the season of the Engelmann Botanical Club was held in the Graduate Lecture Room on the afternoon of June 7th. Mr. C. W. Garrett, of the Garden, spoke on "Growing of Hardy Roses," and Mr. W. S. Wells, also of the Garden staff, discussed "Growing Roses Under Glass." The members and visitors then adjourned to the Rose Garden for a demonstration of some of the points brought out.



STATISTICAL INFORMATION FOR JUNE, 1913.

Garden Attendance:

Total number of visitors	27,180

Seed Exchange:

Total number of packets distributed	95
Total number of packets received	325

Library Accessions:

Total number of books and pamphlets bought	9
Total number of books and pamphlets donated	62

Herbarium Accessions:

By Purchase—	
E. Bartholomew, "Fungi Columbiani" Cent. XL	100
E. Bartholomew, "N. A. Uredinales" Cent. VIII	100
By Gift—	
C. R. Orcutt, Texas Plants	83
G. R. Hill, Jr., Utah Plants	50
Moses Craig, Missouri Plants	200
J. M. Greenman, Illinois, Indiana and Michigan Plants	625
Total	2,135

The Garden is open to the public Sundays until Nov. 30th from 2:00 P. M. until sunset. Week-days the year 'round from 8:00 A. M. until one-half hour after sunset. Admission Free.

Personally conducted trip through Garden every Saturday afternoon from May 1 to Nov. 1, starting from Main Gate at 3:00 P. M. Other trips may be arranged for by special appointment.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

STAFF
OF THE MISSOURI BOTANICAL GARDEN

Director,
GEORGE T. MOORE.

Assistant to the Director,
JACOB R. SCHRAMM.

BENJAMIN MINGE DUGGAR,
Plant Physiologist.

EDWARD A. BURT
Mycologist and Librarian.

HERMANN VON SCHRENK,
Plant Pathologist, *Honorary.*

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CARL GARRETT,
In Charge of N. A. Tract and Rose Garden

GEORGE PRING,
In Charge of Orchids and Exotics

HENRY MEIER,
In Charge of Main Garden

MAX SCHILLER,
In Charge of New Plant Range

Missouri Botanical Garden Bulletin

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Chancellor of Wa

THE WATER GARDEN

Missouri Botanical Garden Bulletin

Vol. I St. Louis, Mo., July, 1913 No. 7

WATER GARDENS.

To the uninitiated the cultivation of the water lily seems rather difficult. These plants bear magnificent flowers, both as to size and color, and rather naturally give the impression that it requires long experience and a considerable outlay of money to grow them. It is the purpose of this article to give some idea of what has been done toward the growing of water lilies in the Garden this summer, and to encourage, if possible, the construction of similar gardens on a smaller scale in private places.

Location.—Up to the present year the area in the Garden devoted to the growing of water plants consisted of six small pools. Three of these, formerly located to the northwest of the main entrance, were wrecked this spring to make room for improvements. The other three, just south of the Linnean house, still remain. One of these, the central one, is of concrete; the other two, one to the east and one to the west, are puddled or clay pools. The latter, on account of their peculiar form, are known as the "Horseshoe Ponds." The west horseshoe pond is used for growing the hardy water lilies, while the east one is reserved mostly for the growing of seedling water lilies. The concrete or Victoria pond, so called because in it are grown the large-leaved Royal or Victoria water lilies, is artificially heated in order to provide a sufficiently high temperature for these tropical plants during the cooler months of spring. A portion of the old parterre was this year converted into a water garden. This pool, rectangular in shape, is seventy by one hundred and forty feet, and is the largest single pool in Saint Louis given over to the growing of water lilies. It is this pool that is

Construction.—Pools for the growing of water lilies may be made of either concrete or clay. Where the subsoil is clay, as is the case generally in this section of the country, the latter type of pool is much more cheaply constructed and has the additional advantage of appearing more natural. However, in cases where the subsoil is such that free drainage results, it sometimes becomes necessary to construct concrete pools. All the new pools made in the Garden this spring were built of clay. The clay subsoil in the Garden lies only a few feet below the surface, so that it was only necessary to dig through the surface loam to uncover it. When the clay itself was reached, a basin with vertical sides was dug out two feet deep. After the clay had been removed, the basin was refilled with one foot of well-mixed soil containing a large percentage of cow manure. Finally, water was allowed to run in until one foot of water covered the foot of good soil. A mistake is often made in thinking that lilies need nothing but water for their growth, but a soil layer for properly feeding the plants is just as important. As the plants become older the depth of the water can be gradually increased by adjusting the overflow. Pools constructed in solid clay, as above, practically never leak.

Where a solid clay subsoil is not available, a process of puddling is employed. This consists, essentially, of plastering the sides of the excavation with a layer of clay—the addition of water making easy the application of the clay. Pools so constructed need very little attention and leak but little more than solid clay pools, and have an advantage over concrete in that they can be enlarged or remodeled at any time without much expense.

The construction of concrete tanks usually requires the assistance of a mechanic and does not lend itself well to natural surroundings. The formal concrete pool should not be used except in conjunction with other formal surroundings.

Water Supply.—After the initial filling of the pools, it requires but a small stream to keep the water fresh and clean. It is necessary, of course, to prevent scum from accumulating on the surface of the water, as well as to avoid providing a place for the breeding of mosquitoes. If a half-inch stream of water be allowed to run slowly into the pool,

sufficient to poison the plants making up the scum, and yet too dilute to harm the lilies. Fish are usually introduced into a water garden to keep it free from mosquito larvæ, although it should be remembered that if the pool is in an exposed place, subject to the action of the wind, there is little danger of its becoming a nuisance, since mosquitoes will not breed where the water is rippling. The water which supplies the garden pools is furnished by a three-quarter-inch pipe, running very slowly. This is sufficient to keep scum from accumulating on the surface and supplies enough water to make up for the loss by evaporation.

Drainage.—Water garden pools are usually located in rather low places, and hence, in time of rainy weather, receive the drainage from the adjoining slopes. The small pipe which takes care of the normal overflow will not carry off this storm water and provision must be made for the latter. If a large tile is so laid that its bottom is at the same level as the normal surface of the water, this surplus will usually be taken care of, although where the drained area is very large, more tiles may be necessary. A few heavy rains will soon show how much extra drainage is necessary.

Classification of Lilies.—Water lilies may be roughly divided into two classes—tender and hardy varieties. The former may be again divided into those requiring artificial heat and those that do not. The hardy lilies, of course, are those capable of withstanding the winter without protection. Practically the only water lilies that require artificial heat are the large-leaved Royal or Victoria lilies. Even these will flower and produce fairly large leaves without additional heat, but the results are so much better when artificial heat is added in cool weather, that this method of growing them is much practised. Heat is applied only when the normal temperature of the water falls below 80° Fahrenheit.

Propagation.—Lilies are raised from seed germinated during the winter in tanks under glass, and the resulting seedlings are transplanted to the outdoor ponds late in the spring. Or, plants may be taken up in the fall and kept over winter in tubs protected from frost. Once the hardy lilies are planted out they require but very little subsequent attention.

and most brilliantly flowering forms belong to the latter class, opening in the late afternoon or evening and not closing until nine or ten o'clock the next morning. The day bloomers usually open in the morning at about the time the night bloomers close, being at their best from eleven to twelve o'clock. The same lily will bloom for several days, opening and closing each day, but fading and drooping more and more until finally its head sinks below the surface of the water, where the seeds are formed. The colors are usually brightest when the flowers first open.

Where to find the Water Lilies in the Garden.—West Horseshoe Pond.—This contains the following of the hardy lilies: *Nymphæa tuberosa,* "Richardsoni," "Marliacea carnea," "Marliacea rosea," "Marliacea Gladstoniana," "Marliacea chromatella" and "James Bryden."

Victoria Pond.—This contains the large-flowered and large-leaved *Victoria Cruziana,* or Amazon River lily, which is one of the most attractive of the water lilies. The leaves, from edge to edge, including the large rolled margin, some times attain a diameter of eight feet, while six and seven feet is not uncommon late in the season. The flowers open about a half hour after sunset and at that time give off a very sweet odor.

East Horseshoe Pond.—This pond contains, besides *Nymphæa Boucheana, N. ortgiesiana* var. *rubra,* and *N. rubra rosea,* the following varieties of water lilies: "Stella Gurney," "C. W. Ward" and "George Huster."

Water Garden.—The following varieties of water lilies are in the Water Garden, arranged in large groups around the edges: *Victoria Cruziana, Nmyphæa zanzibariensis* red, *N. zanzibariensis* blue, *N. Lotus dentata, N. Devoniensis, N. gracilis,* and "Frank Trelease," "Hofgärtner Grabner," "D. R. Francis," "Amazonica," "James Gurney Jr.," "Pink O'Marana," "Lotus Jubilee," "Columbiana," "Kewensis," "Deaneana" and "Rufus J. Lackland." Many of these varieties were originated by Mr. James Gurney, Head Gardener Emeritus of the Garden. Two of Mr. Gurney's latest creations, a deep red and a deep blue day-blooming lily, are

of Mr. Gurney's work and are represented in the water garden by "Rufus J. Lackland" and "James Gurney Jr."

Pool No. 1.—This is the first pool south of the water garden and is planted with the following Nymphæas: "Hofgärtner Grabner," "Frank Trelease," "D. R. Francis," and "Euryale ferox"—one of the hardy, large-leaved forms with blue flowers.

Pool No. 2.—This pool is too small for water lilies.

Pool No. 3.—This is planted with *Nymphæa capensis zanzibariensis* red and *Victoria Cruziana* in the center.

Pool No. 4.—This is planted entirely with the blue form of *Nymphæa capensis zanzibariensis.*

Many other interesting water plants, which cannot be enumerated here, are planted around the edges of the water garden, ponds, and pools. The water garden has been constructed since the middle of March, and its appearance at present will afford some idea of what can be accomplished in a short time towards securing a lily pond.

NORTH AMERICAN TRACT.

At the southern edge of the Garden there is a tract of about twenty-five acres, which, although planted ten years ago, still remains unknown to a majority of the visitors to the Garden. Many people hardly realize that the Garden extends so far back from the main entrance and they, therefore, rarely visit this section, which, in spite of its rather obscure location, is one of the prettiest spots in the Garden. Here many of the trees, shrubs and wild flowers of our own country, in fact, of the North American continent, may be found growing. They are arranged according to a definite systematic scheme, for the convenience of the botanical student, but the common names are on all the plants and there is usually someone about to show visitors where the plants are that they may be looking for.

This section was designed to show the possibilities of our native flora in the planting of ornamental masses about home grounds, as well as to form a collection of native plants.

from a survey of this particular portion of the Garden, where only native plants are growing. This applies not alone to the trees and shrubs, but also to the herbaceous plants around the borders.

The North American tract is easily reached from the rose garden. Passing south from the latter and immediately west of the main office building, the beginning of the walk leading around the tract is reached. A small lake to the right presents a rather picturesque appearance with the growth of aquatics along its borders and upon its surface. While they appear more or less wild, they have all been planted with a purpose, representing the group of plants known to the botanist as the Monocotyledons, i. e., plants with certain similarities in flower, stem, and leaf structure that place them naturally in a group by themselves. It is significant that the majority of the plants in the native flora belonging to this class are inhabitants of moist or decidedly wet situations, and a lake of the above nature therefore forms the logical center about which to group them.

This same community of characteristics is the basis of the grouping of the plants all through this tract, and as one passes along the walk to the south of the small stream and chain of pools, one faces a constantly changing flora. In botanical terms the flora is becoming more complex as we proceed. The beginnings of new groups are indicated by small labels bearing the common and scientific names, and are placed in plain view at the edges of the walks.

A copy of Gray's Manual of Botany, sixth edition, will be of great service to a person visiting this section, for a great many of the plants listed in the manual are growing in the tract and, moreover, are arranged in the same order, proceeding westward, as in the manual itself. Occasionally an herbaceous plant will be found which is not strictly a native of North America, but the number of these is so small that they do not disturb the native appearance of the plantations.

THE RED SUNFLOWER.

The Garden is unusually fortunate in being able to exhibit at the present time an entirely new variety of sunflower—the "Red Sunflower." It is through the kindness of Prof. T. D. A. Cockerell, of the University of Colorado, that the Garden is enjoying this privilege, and it is safe to

say that this is one of the very few places in the world where this noteworthy variety may at present be seen.

In Colorado and New Mexico our common sunflower *(Helianthus annuus)* is abundantly represented by a form which differs somewhat from the cultivated type and is known as the form *lenticularis*. The type just referred to has golden yellow ray flowers with a central disk of dark, purplish red. In 1910, Mrs. Cockerell found, at Boulder, Colorado, a single plant among a host of others which possessed ray flowers deeply tinted with chestnut red. This plant Professor and Mrs. Cockerell removed to their own garden, where under the very best of care, it continued to grow and flower.

Unfortunately, the flowers on a sunflower plant cannot be fertilized with pollen from the same plant, and it therefore became necessary to pollenate the flowers of this original plant with pollen from other non-red varieties. This they did, and from the seed harvested a large number of plants were grown in 1911. Of these about one-half produced fine red flowers. These were again cross-pollenated and, since many plants bearing red flowers were now available, crosses were also made between red-flowered plants.

From the seed obtained from the 1911 crosses a very large number of plants were grown in 1912, among which a handsome form appeared in which the chestnut-red color was confined to a zone in the middle of the ray flowers. To this variety Prof. Cockerell gave the name *bicolor*. Besides this form, however, a considerable number of all-red flowering plants were obtained, in some of which the color was strikingly deep.

With the 1912 flowers, crosses were again made, and it was of the resulting seed that Prof. Cockerell so generously sent a sample to the Garden.

The history of the results obtained by Prof. and Mrs. Cockerell from the various crosses, illustrate, in a very striking manner, the great law enunciated by Mendel over fifty years ago which enables the breeder, both of plants and animals, to predict, with a reasonable degree of certainty, the character of the offspring. Those who may be further interested in looking up the history of the red sunflower will find it amply and interestingly recorded in "Science" for 1910, "Popular Science Monthly" for April, 1912, and "Gardeners' Chronicle" for May, 1913.

The red sunflowers in the Garden will be found in large numbers along the east side of the stone wall which remains standing south of the new plant range. It will at once be apparent to the visitor that not all of the flowers are marked with red; a large number, however, will be seen to have a rich chestnut-red zone in the ray flowers, it being most striking in the flowers that are just opening, becoming less marked with age and disappearing almost entirely before the flowers have finished blooming. A few of the all-red type will also be found, but most of the flowers are of the bicolor type.

It should be said in conclusion that Prof. Cockerell considers the present red sunflower only a step in the development of much more striking red varieties, and it is hoped that the Garden may be able to exhibit these as they are produced.

INTERESTING PLANTS FOR JULY.

On account of the intense heat, the usual floral display in the new plant house has been suspended during the months of July, August and September. Many interesting and beautiful flowering and foliage plants are to be seen, however, both in the old ranges and out-of-doors.

In the front house of the old range two plants of the pea family are attracting considerable attention. They are the sensitive plant *(Mimosa pudica)* and the telegraph plant *(Desmodium gyrans)*. Both of these plants have the peculiar faculty of quickly responding, with their leaves, to external shocks. The sensitive plant has a leaf divided into three parts and each part is clothed with two rows of small leaflets. When the leaf is touched or the plant is jarred, these small leaflets quickly fold together and the plant takes on the so-called sleeping attitude. If the shock has been sufficiently violent the leaflets not only fold together, but the entire leaf bends down at the point where it joins the stem. After having reacted to a stimulus in this manner, the leaf very gradually returns to its original position. When the leaf has been stimulated repeatedly at short intervals, it finally fails to react. The telegraph plant has, near the base of the terminal leaflet, two small ones on opposite sides of

The flowering orchids are especially worthy of notice this month. The most interesting one, "The Star of Bethlehem" *(Angraecum sesquipedale)* has five gigantic flowers measuring thirteen inches in length and from tip to tip of the lateral petals, seven inches. (See plate 16.)

To the Rev. W. Ellis, the missionary and historian of Madagascar, is due the credit of introducing, in 1885, this remarkable orchid. In its native home it inhabits the lowest and hottest districts, growing on the dryest parts of the trunks and branches of thinly-leaved trees. The leaves of the plants are neither numerous nor large and present a half-starved, straggling appearance. The roots are few in number, frequently extending down the tree on which it grows, twelve to eighteen feet, and so tough and adhering so tenaceously to the bark that a considerable force is required to break or detach them.

Flowers of this species were examined by Charles Darwin, and he drew the following interesting inference from his observations: "If the *Angraecum* in its native forest secretes more nectar than the vigorous plant in our hothouses, so that the nectary becomes filled, small moths might obtain their share, but they would not benefit the plant. The pollinia would not be drawn till some huge moth with a wonderful proboscis tried to draw the last drop. If such great moths were to become extinct in Madagascar, assuredly the *Angraecum* would become extinct also. On the other hand, as the nectar, at least in the lower part of the nectary (spur), is stored safe from depredation by other insects, the extinction of the *Angraecum* would probably be a serious loss to those moths." Although it is popularly supposed that a moth has been discovered in Madagascar with a proboscis sufficiently long to reach to the bottom of the remarkably long nectary (spur) and at the same time to pollenate this orchid, no authentic account of its existence can be found.

A cinnamon-odored orchid *(Lycaste aromatica)* will be found on the side stage amidst a collection of blooming epidendrums. Suspended above the center stage is a large plant of *Dendrobium Hookerianum* with two long, sweeping spikes bearing tan-colored flowers with two splotches of cinnamon-red on the inside of the labellum. On the center stage are a large number of flowering orchids, of which the

nodosa and one of the snail shell orchid *(Epidendrum pentalis)* are also in flower. In the former the labellum is strikingly protruded and conspicuous, whereas the remaining petals are small and inconspicuous; in the latter the flowers are so curiously modified and contorted as to resemble, somewhat, a snail shell.

Out-of-doors.—Near the southeast and southwest corners of the new water garden (mentioned at another place in this BULLETIN) habitual visitors to the Garden will be surprised to find, in the shade of trees, the tuberous begonias still flowering—the same ones which were exhibited for almost two months in the display house of the new plant range. The cannas planted on the knolls near the new conservatory are beginning to show good flowers. New among these are "Blanche Wintzer," a variety with extremely large and almost pure white flowers; "Conowinga," "Beacon" and "Black Prince," with flowers respectively scarlet, deep red and very dark red; and "Florence Vaughn," with petals so speckled with yellow and bronze as to remind one of the rainbow trout.

A solid bed of petunias flanking one of the knolls is the brightest bit of color now in the Garden, but masses of phlox and mallow in great variety of color and of the pale blue leadwort *(Plumbago capensis)* skirting other knolls, are beginning to flower and will soon bring striking touches of color to the sides of the other valleys.

Although the roses are past their prime, a goodly number of flowers are still being put forth which will more than repay the visitor for a trip to this part of the Garden.

Many of the tropical plants housed during the colder weather have been brought out-of-doors and grouped around the old conservatory. Many of the well-known collections with which the visitors were familiar in the houses will now be found here.

GEORGE W. LETTERMAN.

George W. Letterman was born near Bellefonte, Center County, Pennsylvania, 1841, and died at Allenton, Missouri, May 28, 1913. His father was of Dutch and his mother of

in the Union Army; he served throughout the remainder of the war and received an honorable discharge with the title of captain of volunteers.

In 1869 Mr. Letterman settled at Allenton, Missouri, where he soon became teacher in the public school and held this position for about twenty years. He then served for two years as superintendent of schools for St. Louis County and subsequently resumed teaching in his adopted town.

Letterman's interest in botany seems to have been incited by Mr. August Fendler, the well-known Venezuelan collector, whom he met soon after going to Allenton. From 1870 to a few months prior to his death, or for approximately forty years, Letterman continued an active interest in science, and, through his extreme generosity in the distribution of plants collected and ample notes concerning them, he made, by correspondence, many friends both at home and abroad.

Through Prof. Charles Sprague Sargent, Mr. Letterman became a collaborator in the preparation of the noted Jesup collection of North American woods, now in the American Museum of Natural History in New York City.

Letterman was never married, and his extremely retiring nature led him to live a very modest and isolated life. He apparently had no desire to achieve a reputation through publication, even to recording the results of his own observations; but his greatest pleasure was in imparting information to his pupils, and studying afield the flora and fauna of the beautiful country in which he lived—the wooded hills and valley of the Meramec river.

To botanists Letterman was known as a keen and discriminating collector, particularly of Missouri plants, but to the people of his own immediate community, on whom he has left a lasting impression, he will long be remembered as an elevating friend and inspiring teacher.

NOTES.

On May 30, Dr. J. M. Greenman, Curator of the Herbarium, attended the funeral of the late George W. Letterman, at Allenton, Missouri.

Mr. Droushel, of the Teachers' College, recently brought his summer school class in botany to the Garden. Mr. Droushel frequently consults the Garden herbarium and has on many occasions donated interesting specimens to the collection.

Mr. L. O. Kunkel, Rufus Lackland Fellow during the year 1911-12, visited the Garden on June 27. Mr. Kunkel has been assistant to Dr. Harper at Columbia University during the past year and will have charge of the summer school work in plant physiology at the same institution during the present season.

Dr. Moore, Director of the Garden, is spending the months of July and August in Wood's Hole, Massachusetts, where, as in former years, he is directing the work in the botanical department of the Marine Biological Laboratory and personally conducting the course in Morphology and Taxonomy of the Algæ. Dr. B. M. Duggar, Plant Physiologist to the Garden, is likewise spending the summer at the Marine Biological Laboratory. Besides doing active work in research, Dr. Duggar is giving a course on the Physiology and Ecology of Marine, Strand and Bog Vegetation.

A feature of the recent Commencement Exercises at Middlebury College was the presentation of a purse to Dr. E. A. Burt, Mycologist and Librarian-elect, to the Missouri Botanical Garden, to be used as he sees fit in his research work. The following letter was read from the alumni:

> As the Commencement of 1913 of Middlebury College marks the departure of one of the professors best known to the recent alumni, Dr. Edward Angus Burt, members of the classes 1896-1912, inclusive, desire to express their appreciation of his services during the past eighteen years.
>
> The gift which they present is but a slight expression of the deep regard they have for him as a scholar, a teacher and a friend. Now that Middlebury is making great strides in material progress, there is need to keep in mind the fundamental truth, that a college is great only in so far as she has great teachers. Such a great teacher the recent alumni consider Dr. Burt, the worth of whom they have come to appreciate more and more as the years have advanced. They congratulate him upon the scientific honor of his new position, and extend to him their best wishes.
>
> Signed by the Committee for the Alumni 1896-1912.

STATISTICAL INFORMATION FOR JUNE, 1913.

Garden Attendance:

Total number of visitors	18,142

Seed Exchange:

Total number of packets distributed	117
Total number of packets received	148

Plant Distribution:

Total number of plants distributed	2,236

Library Accessions:

Total number of books and pamphlets bought	52
Total number of books and pamphlets donated	313

Herbarium Accessions:

By Exchange—

New York Botanical Garden—West Indian plants	375

By Purchase—

J. M. Greenman—Arizona plants	237
Albert Ruth—Texas plants	278

By Gift:

A. M. Huger—*Sedum ternatum* Michx.—North Carolina	1
Rev. Francis L. Palmer—*Habenaria bracteata* (Willd.) R. Br.—from Minnesota	1
Mrs. J. F. Allen—*Allium nigrum L.*—cultivated plant	1
James H. Clendening—*Dracunculus vulgaris* Schott.—cultivated plant	1
Bernard Mackensen—*Solanum Torreyi* Gray—from Texas	1
C. Conzatti—*Phaseolus* sp.—Mexico	1
New York Botanical Garden—*Lemna perpusilla* Torr.—from Porto Rico	1
C. R. Orcutt—Plants of Texas	250
O. S. Ledman—Massachusetts and Washington plants	4
L. M. Dougan—*Stylosanthes biflora* (L.) B. S. P.—Missouri	2
Total	1,153

The Garden is open to the public Sundays until Nov. 30th from 2:00 P. M. until sunset. Week-days the year 'round from 8:00 A. M. until one-half hour after sunset. Admission Free.

Personally conducted trip through Garden every Saturday afternoon from May 1 to Nov. 1, starting from Main Gate at 3:00 P. M. Other trips

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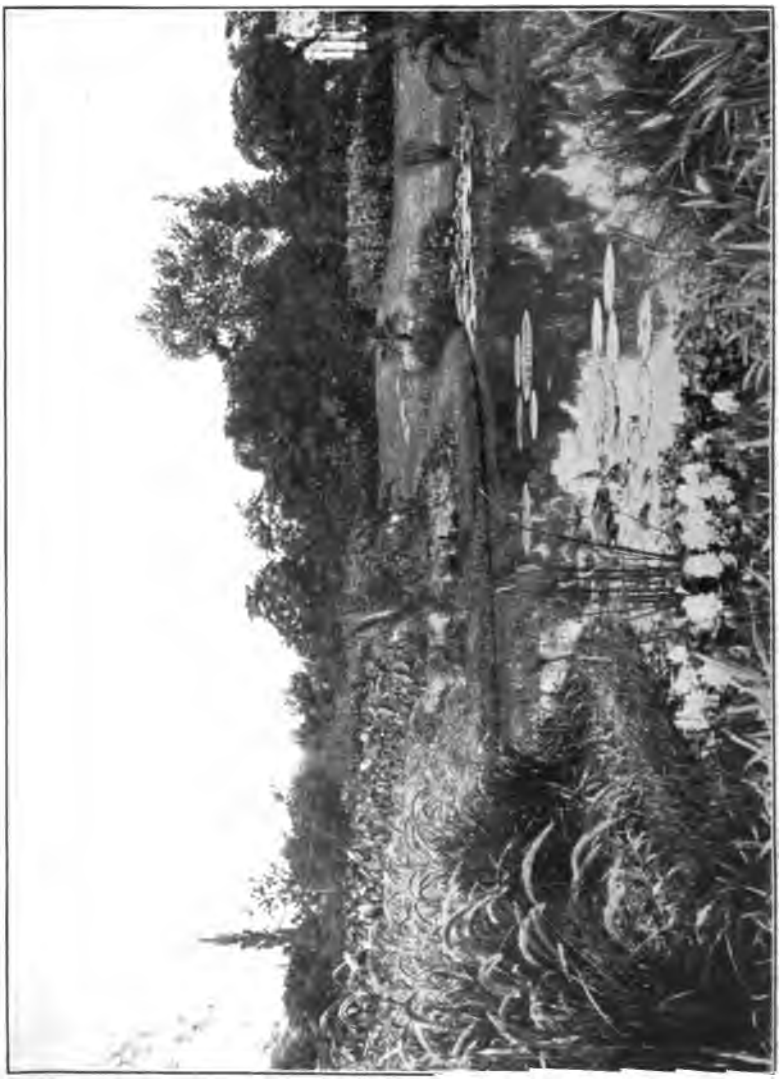
A. D. CUNNINGHAM, Secretary



IN THE MAIN GARDEN.
LOOKING SOUTHWEST FROM THE WATER GARDEN.

Missouri Botanical Garden Bulletin

Vol. I St. Louis, Mo., August, 1913 No. 8

THE MEDICINAL GARDEN.

A medicinal garden, where many of the plants from which our drugs are prepared may be seen growing, is one of the unique features of the Garden. Attention was called in the last number of the BULLETIN to the comparatively little known North American tract—a large area devoted to the growing of plants indigenous to our continent. The medicinal garden, on account of its rather secluded location and small size, is perhaps even less well known than the North American tract. Like the latter, however, it is full of interest and deserves to become more popular with Garden visitors. Here plants from the poison hemlock, a decoction of which became the death potion of Socrates, to the white pine, whose soothing properties are familiar to all, have been assembled in a small area and, for the convenience of visitors, arranged into groups according to their physiological action.

The use of plants in the treatment of diseases is the oldest phase of applied botany. In the early centuries the interest in plants centered almost entirely in the medicinal virtues which they were thought to possess. Theophrastus and Aristotle among the Greeks, and Pliny and Dioscorides among the Romans, wrote extensive treatises on plants, laying emphasis on their reputed medicinal properties. These medicinal properties were, however, in most cases, more mythical than real. Very early there had sprung up the so-called "Doctrine of Signatures," which supposed that any external resemblance in a plant to any organ of the body indicated its usefulness in curing ailments of that particular organ. From this doctrine such names as "lungwort," "liverwort" and many similar ones have come down to us.

Pharmacology made little or no advance from the time of the Romans to comparatively recent times. It continued to

having the opposite effect from that of the disease, gained prominence. It is this doctrine, in a modified form, which later became known as allopathy, in distinction from the doctrine of homeopathy which began to gain adherents late in the eighteenth century. This advocated the cure of diseases with drugs having an action similar to that of the disease itself. But the real progress in pharmacology came when the true causes of disease were discovered and the actions of drugs scientifically investigated. Generalizations, superstitions and myths gave way to rational experimentation, and to-day pharmacology holds a dignified position among the other natural sciences. It is true that some drugs are still applied empirically, following the dictates of experience, but this is because the disease is imperfectly known. The rational administering of drugs presupposes a thorough knowledge of the disease.

While the advance in pharmacology has added many animal and mineral products to the pharmacists' shelves, vegetable drugs still occupy a very prominent place. Their collection and preparation is an important industry and, while the great bulk of medicinal plants are gathered from their native haunts, the large demand for certain ones has made their cultivation necessary and profitable. In the medicinal garden of the Missouri Botanical Garden over 500 recognized drug-yielding plants have been assembled and segregated into groups according to their accepted physiological action. It is, of course, not possible to indicate the special uses for which each plant is suited. For this information special treatises on materia medica must be consulted.

The medicinal garden lies west of the rose garden, and may be reached by a cinder path starting at the tall cypress tree directly west of the rose pergola. While the collection contains upwards of 500 medicinal plants, not all of these may be seen growing at any one time. Thus, at present, the spring- and early summer-flowering plants will be found missing in many instances, having already flowered and disappeared. But the following enumeration of the plants at present growing in the medicinal garden will give some idea of the classes of drug plants represented, as well as of the species themselves.

Class 1. Antispasmodics—Agents which prevent or allay spasm of voluntary or involuntary muscles in any portion of the organism. Poison hemlock (*Conium maculatum*)

carolinense), belladonna *(Atropa Belladonna)*, wild yam-root *(Dioscorea villosa)*, ipecac *(Euphorbia ipecacuanhæ)*, scopola *(Scopolia carniolica)*.

Class 2. Anæsthetics and Anodynes—Agents which temporarily destroy sensation. Belladonna *(Atropa Belladonna)*, spearmint *(Mentha spicata)*, peppermint *(Mentha piperita)*, thyme *(Thymus vulgaris)*, hemp *(Cannabis sativa)*.

Class 3. Hypnotics and Narco-hypnotics—The former are agents which produce sleep without rendering the subject unconscious to pain, whereas the latter, in larger doses, suspend, in addition, the consciousness of pain. Stramonium, or white-flowered jimson weed *(Datura Stramonium)*, purple thorn-apple or purple-flowered jimson weed *(Datura Tatula)*, hop *(Humulus Lupulus)*.

Class 4. Deliriants—Agents which disorder the mental faculties to a greater or less degree. They are all narcotics, though all narcotics are not deliriants. Water pepper *(Polygonum Hydropiper)*, purple and white-flowered jimson weed *(Datura Tatula* and *D. Stramonium)*, hemp *(Cannabis sativa)*.

Class 5. Motor Excitants—Agents which increase the functional activity of the spinal cord and the motor apparatus, producing disturbances of motility and heightened reflex excitability. In large doses their ultimate effect is motor paralysis from overstimulation. Lily of the valley *(Convallaria majalis)*, milfoil or yarrow *(Achillea Millefolium)*, oat *(Avena sativa)*.

Class 6. Motor Depressants—Agents which lower the functional activity of the spinal cord and other parts of the motor apparatus and, in large doses, paralyze them. Poison hemlock *(Conium maculatum)*, tobacco *(Nicotiana Tabacum)*, Indian tobacco *(Lobelia inflata)*.

Class 7. Antiperiodics—Agents which affect certain periodic febrile diseases, lessening the severity of the periods or preventing their return. Golden seal *(Hydrastis canadensis)*, quinine or cinchona tree *(Cinchona officinalis)*, jimson weed *(Datura Stramonium)*, sweet flag *(Acorus Calamus)*.

Class 8. Antipyretics—Agents which reduce the body

Class 9. Hemostatics—Agents administered internally to arrest bleeding. Witch-hazel *(Hamamelis virginiana)*, ribgrass *(Plantago lanceolata)*.

Class 10. Astringents—Agents which produce contraction of muscular, and condensation of other, tissues. Agrimony *(Agrimonia gryposepala)*, sea lavender *(Limonium carolinianum)*, dead nettle *(Laminum album)*, smooth sumac *(Rhus glabra)*, periwinkle *(Vinca minor)*, alum root *(Heuchera americana)*, stinging nettle *(Urtica dioica)*, wild red-raspberry *(Rubus indæus* var. *aculeatissimus)*, dog-rose *(Rosa canina)*, patience dock *(Rumex patientia)*, sweet sumac *(Rhus canadensis)*.

Class 11. Gastric Tonics—Agents which increase the appetite and promote gastric digestion. Summer savoy *(Satureja hortensis)*, burdock *(Arctium minus)*, figwort *(Scrophularia marilandica)*, peppermint *(Mentha piperita)*, witch-hazel *(Hamamelis virginiana)*, hop *(Humulus Lupulus)*, northern prickly ash *(Zanthoxylum americanum)*, sweet flag *(Acorus Calamus)*.

Class 12. Alteratives—Agents which in some little-understood manner alter the course of morbid conditions. Northern prickly ash *(Zanthoxylum americanum)*, blue flag *(Iris versicolor)*, moonseed *(Menispermum canadense)*, English elm *(Ulmus campestris)*, *Colchicum autumnale*, golden seal *(Hydrastis canadensis)*.

Class 13. Diaphoretics and Sudorifics—Respectively mild and energetic agents in promoting the secretion of sweat. Sassafras *(Sassafras variifolium)*, burdock *(Arctium minus)*, catnip *(Nepeta Cataria)*, elder *(Sambucus canadensis)*, wormwood *(Artemisia Absinthium)*.

Class 14. Emetics and Anti-emetics—Agents which respectively produce and diminish nausea and vomiting. Waxwort or climbing bitter-sweet *(Celastrus scandens)*, mustard *(Brassica alba)*.

Class 15. Cathartics, including laxatives and purgatives. Buckthorn *(Rhamnus cathartica)*, burning bush or waahoo *(Evonymus atropurpureus)*, yellow flag *(Iris pseudacorus)*, Culver's physic *(Veronica virginica)*, green ash *(Fraxinus*

vulgare), horseradish *(Radicula Armoracia)*, peppermint *(Mentha piperita)*.

Class 18. Diuretics—Agents which stimulate the secreting cells of the kidneys. Tobacco *(Nicotiana Tabacum)*, savin *(Juniperus horizontalis)*, Indian hemp *(Apocynum cannabinum)*, white birch *(Betula alba)*, lily of the valley *(Convallaria majalis)*, asparagus *(Asparagus officinalis)*, hemp *(Cannabis sativa)*.

Class 19. Sternutatories—Agents which produce, when locally applied to the mucous membrane of the nose, increased nasal secretion and sneezing. Coffee *(Coffea Arabica)*, belladonna *(Atropa Belladonna)*, stramonium *(Datura Stramonium)*.

Class 20. Anhidrotics—Agents which check perspiration and are, therefore, opposite in their action to diaphoretics. Belladonna *(Atropa Belladonna)*, stramonium *(Datura Stramonium)*.

Class 21. Parasiticides—Agents which destroy animal and vegetable parasites found upon the human body. Tobacco *(Nicotiana Tabacum)*, peppermint *(Mentha piperita)*.

Class 22. Expectorants—Agents which modify the secretion of the broncho-pulmonary mucous membrane and promote its expulsion. Pleurisy-root *(Asclepias tuberosa)*, wild yam-root *(Dioscorea villosa)*, liquorice *(Glycyrrhiza glabra)*, elecampane *(Inula Helenium)*, white pine *(Pinus Strobus)*, mullen *(Verbascum Thapsus)*.

Class 23. Oxytocics—Cotton *(Gossypium herbaceum)*.

Class 24. Emmenagogues. Tansy *(Tanacetum vulgare)*, common rue *(Ruta graveolens)*, fennel *(Foeniculum vulgare)*, wild marjoram *(Origanum vulgare)*, water pepper *(Polygonum Hydropiper)*, rye *(Secale cereale)*.

Class 25. Sialogogues—Agents which increase the secretion and flow of saliva and mucus in the mouth. Pellitory *(Anacyclus Pyrethrum)*, fever few *(Chrysanthemum Parthenium)*, northern prickly ash *(Zanthoxylum americanum)*.

Class 26. Irritants—Agents which, when applied to the skin, produce a greater or less degree of vascular excitement

Class 27. Demulcents—Oily or mucilaginous substances which sooth and protect the parts to which they are applied. Hound's tongue *(Cynoglossum officinale)*, comfrey *(Symphytum officinale)*, rice *(Oryza sativa)*, flax *(Linum usitatissimum)*, rib grass *(Plantago lanceolata)*.

Class 28. Galactagogues—Agents which are supposed to increase the lacteal secretion. Castor-oil plant *(Ricinus communis)*, cotton *(Gossypium herbaceum)*, fennel *(Foeniculum vulgare)*.

Class 29. Galactophyga—Agents which diminish or suppress the lacteal secretion. Belladonna *(Atropa Belladonna)*, tobacco *(Nicotiana Tabacum)*.

Class 30. Anthelmintics—Agents which destroy (vermicides) or expel (vermifuges) worms inhabiting the intestinal tract. Castor-oil plant *(Ricinus communis)*, thyme *(Thymus vulgaris)*, wormwood *(Artemisia vulgaris)*, Mexican tea *(Chenopodium ambrosioides)*, squash *(Cucurbita maxima)*.

Class 31. Antiseptics and Disinfectants—Agents which arrest the development of or destroy putrefactive and pathogenic bacteria. Peppermint *(Mentha piperita)*, thyme *(Thymus vulgaris)*, eucalyptus *(Eucalyptus globulus)*, sweet gum tree *(Liquidambar Styraciflua)*.

Class 32. Poisons. Water hemlock *(Conium maculatum)*, stonecrop *(Sedum acre)*, poison ivy or poison oak *(Rhus Toxicodendron)*, belladonna *(Atropa Belladonna)*, water hemlock *(Cicuta maculata)*, purple and white-flowered jimson weed *(Datura Tatula* and *D. Stramonium)*, corn cockle *(Agrostemna Githago)*, pokeweed *(Phytolacca decandra)*.

Class 33. Aromatics. Peppermint *(Mentha piperita)*, sweet gum tree *(Liquidambar Styraciflua)*, ground ivy *(Nepeta hederacea)*, silky cornel *(Cornus Amomum)*, white-flowered sage *(Salvia officinalis)*, hop tree or shrubby trefoil *(Ptelea trifoliata)*, fennel *(Foeniculum vulgare)*, spearmint *(Mentha spicata)*, horse mint *(Monarda punctata)*, pennyroyal *(Hedeoma pulegioides)*.

A large number of other medicinal plants with such varied

NOTES.

The roses, notwithstanding the unusually hot and dry summer, are continuing to bloom almost as prolifically and beautifully as in the earlier season.

The shrubbery and trees transplanted this spring have suffered from the long-continued drought and, while some of each have died, the percentage of loss will be low. It has been possible to save so large a per cent, however, only by persistent and thorough attention to watering. At times it became necessary to continue the watering at night.

The private herbarium of the late Henry Eggert, which was purchased by the Missouri Botanical Garden and of which up to the present year 26,704 specimens have been incorporated in the general collection, is now fully organized and the duplicate material, numbering about 10,000 specimens, is ready for exchange with the Garden's correspondents.

In the July issue of the BULLETIN the use of copper sulphate in ridding ponds of scum was recommended. Since that time it has become necessary to treat several ponds in the Garden. This has been done by adding about one part of copper sulphate to two million parts of water. The scum was quickly killed, but none of the other plants growing in the ponds suffered the least injury.

The need for more space in the herbarium has been met temporarily by the installation, during the past month, of a few new cases which give an additional capacity for approximately 40,000 mounted specimens. The work has involved a complete rearrangement of more than one-half of the entire herbarium, with the result, however, of rendering it possible to incorporate the large amount of undistributed material on hand and accommodating the normal growth of the herbarium during the coming year.

The front houses of the new plant range are being filled with from three to five feet of rich top-soil mixed with manure and coarse raw crushed bone. This is being done in order to furnish an ample depth of rich soil for the large tropical plants which will be set out directly in it. When the work of excavation for the new plant range was begun, all the top soil over the area to be excavated was kept separate and

STATISTICAL INFORMATION FOR JULY, 1913.

GARDEN ATTENDANCE:

Total number of visitors	17,357

SEED EXCHANGE:

Total number of packets received	12

PLANT DISTRIBUTION:

Total number of plants distributed	288

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	16
Total number of books and pamphlets donated	132

HERBARIUM ACCESSIONS:

By Exchange—	
Field Museum of Natural History—*Senecio palustris* Hook.—from Wisconsin	1
Bureau of Plant Industry, U. S. Dept. of Agr.—Plants of Siberia, China, Turkestan and Mongolia	53
By Gift:	
J. A. Drushel—Plants of Missouri	18
J. M. Greenman—*Carya* sp.—from Missouri	2
A. M. Huger—*Liparis liliifolia* (L.) Richard—from North Carolina	1
A. Koch—*Piper auritum* Kunth.—Cultivated Plant	1
N. Y. Botanical Garden—*Sclerocarpus* sp.—from St. Thomas, W. I	1
Wm. E. Smith—*Poa compressa* L.—from Illinois	1
J. R. Schramm—*Solanum rostratum* Dun.—from Missouri	1
C. H. Swift—*Habenaria*—from Michigan	3
H. von Schrenk—*Dicentra canadensis* (Goldie) Walp.—from Michigan	1
TOTAL	83

The Garden is open to the public Sundays until Nov. 30th from 2:00 P. M. until sunset. Week-days the year 'round from 8:00 A. M. until one-half hour after sunset. Admission Free.

Personally conducted trip through Garden every Saturday afternoon

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Head Gardener, *Emeritus.*

WILLIAM W. OHLWEILER,
General Manager.

CARL GARRETT,
In Charge of N. A. Tract and Rose Garden

GEORGE PRING,
In Charge of Orchids and Exotics

HENRY MEIER,
In Charge of Main Garden

MAX SCHILLER,
In Charge of New Plant Range

Missouri Botanical Garden Bulletin

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ST. LOUIS, MO

BOARD OF TRUSTEES
OF THE MISSOURI BOTANICAL GARDEN

THE ORIGINAL MEMBERS WERE DESIGNATED IN MR. SHAW'S WILL, AND THE BOARD SO CONSTITUTED, EXCLUSIVE OF THE *EX-OFFICIO* MEMBERS, IS SELF-PERPETUATING.

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A. D. CUNNINGHAM, Secretary

PEANUT PLANTS IN HERBACEOUS TRACT.
THE ARROW INDICATES ONE OF THE PEGS.

Missouri Botanical Garden Bulletin

Vol. I St. Louis, Mo., September, 1913 No. 9

THE PEANUT.

In the collection of agricultural plants in the Herbaceous Tract southwest of the new range of greenhouses will be found a small plot of peanut plants. The extensive use of the peanut as an article of food, the value of the green parts for fodder, the soil enriching qualities of the roots and, most of all, the peculiar habit of the plant of maturing its seeds underground, makes it one of especial interest. The peanut belongs to the same family as do the beans and peas, but differs from them markedly in its habit of maturing the seeds underground, a fact emphasized by its technical name, *Arachis hypogaea*. It is also known under the local names of "goober," "goober pea," "pindar," "ground pea," and "groundnut."

The plant is a trailing, straggling annual from one to two feet high with thick, hairy stems and spreading branches bearing orange yellow flowers in the leaf axils. While the flowers are apparently stalked, closer inspection shows that the supposed peduncle is really only a much elongated calyx tube. The base of the latter fits over the small sharp-pointed ovary hidden among the stipules at the base of the leaf. As soon as pollination has taken place, the visible portion of the flower withers and at the same time the short, stout peduncle supporting the ovary begins a period of rapid elongation, bending downward and carrying the sharp-pointed ovary into the ground. The ovary once buried, rapidly develops into the pod with its contained seeds. In case, however, the ovary fails to penetrate the soil, no pod develops. In brief, the peanut flowers and is pollinated above ground like most plants, but this accomplished the flower stalk quickly pushes the potential pod down into the ground where the pod and seeds are developed. The old idea that

Like many other members of the pea family, the peanut, through the instrumentality of certain bacteria living in little nodules on the roots, is able to collect and store free nitrogen from the atmosphere. This nitrogen, if allowed to remain in the soil, is a valuable and indispensable source of plant food. Most of the agricultural crops, instead of increasing the nitrogen supply in the soil, tend constantly to reduce it, consequently the value of the peanut, as well as other members of the pea family, is apparent in a system of crop rotation. A specimen on display in the Garden shows the root nodules.

While the peanut has not been found in a truly wild state, species closely allied to it are natives of Brazil, and there seems to be every indication that our common peanut is a native of tropical America. Its introduction into the United States dates back to the early period of colonization, where we find it becoming established along the James River in Virginia. It was not until about 1870, however, that the peanut became an agricultural crop of importance, but since that time its production has made rapid progress, and in 1908 the crop of the United States was estimated at $12,000,000.

About five varieties of peanuts are grown in the United States. Of these the "Virginia Runner" and "Virginia Bunch" produce large peas such as are commonly used in our markets for parching. The "African" or "North Carolina" produces a medium-sized pea used for shelling purposes and for the smaller grades of parching stock. The "Spanish" and "Valencia," or "Tennessee Red," both have small peas and are extensively used for salted peanuts, peanut butter and peanut candy.

It is not the pea alone, however, which is useful. The tops of the plants furnish hay with a feeding value equal to that of the best clover hays. Inferior peas furnish an excellent hog feed, as does also the cake obtained from the ground peas after pressing out the oil. The oil serves the same purpose as cotton seed oil and olive oil, and millions of bushels are annually used in its production. Peanuts are finding, in addition, ever-increasing use in the manufacture of peanut butter, peanut flour and vegetarian meat substitutes, as well as in various confections.

THE CAPE LEAD-WORT.

and habit of growth. It is a native of South Africa, and like most other South African plants, requires plenty of sunshine and not too much atmospheric moisture. In shade and moisture of the sort that is usually present in greenhouses, the cape lead-wort makes only a weak growth and produces but few flowers. Out-of-door conditions in St. Louis during the summer months are ideal for the growing of this lead-wort. One bed at the Garden is still attracting considerable attention and will continue to do so until frost. It has been noticeable that for a few days after a rain, and while the humidity resulting from it is still high, very few flowers appear, but as soon as the sun comes out the flowers begin to open. During the driest of the summer months, the plumbago was at its best.

The flowers of the lead-wort are noteworthy because of their color. Pale blue is rarely found in flowers, but in this one it is developed to perfection. The inflorescence is a terminal spike of several flowers which often resembles an umbel. As a cut flower for the house, it does not last for any length of time, but will do well if the stems are cut long and the flowers placed in subdued light and out of a draught.

The culture of this plumbago is comparatively easy. New plants can be raised from seeds, cuttings, or "slips," and from division of the old plant. When plants are raised in the fall they can be stored in a cellar or other place protected from cold and set out in the open ground in the spring after danger of frost is over. It is quite possible that plumbago, with a little protection, will stand the mild winters of St. Louis, and an attempt will be made to carry over some of these plants out of doors this winter. Plants about four feet high and full of bloom have been observed in Philadelphia that were undoubtedly hardy there. If *Plumbago capensis* is hardy in this latitude, which seems probable, it will be an important addition to the list of showy plants that will thrive during our St. Louis summers.

AMERICAN SCARLET ROSE-MALLOW.

The family Malvaceae to which this mallow belongs is important from an horticultural standpoint, because of the considerable number of large-flowered, showy plants which

garden, directly opposite the bed of *Plumbago capensis.* The flowers are from five to eight inches across, and blossoming has been profuse since the first of August. Unfortunately, the foliage of this plant is not as attractive as the flower, and does not furnish sufficient background for the large flowers. However, the brightness of the latter more than makes up for this deficiency.

The plants are easily grown from seed and, if started early enough, will bloom the first season. The roots are not hardy and must be taken up in the fall and stored.

NOTES.

Mr. and Mrs. George V. Nash, of the New York Botanical Garden, visited the Garden on September 2nd.

Mr. W. W. Ohlweiler, General Manager of the Garden, spent several weeks in the east visiting botanical gardens, parks and private estates in the interests of the Garden.

Miss Bertha Gericke, recently appointed Librarian at the Agricultural College and Experiment Station, Manhattan, Kansas, visited the Garden library August 30th.

Ruby-throated humming birds have been frequenting the salvia beds in unusual numbers—as many as fifty having been seen at one time. So many are at times busy at a single bed that the hum of their wings is noticeable for a considerable distance.

Dr. J. B. S. Norton and Mr. W. R. Ballard, both of the Maryland Agricultural College, Professor Robert F. Griggs, of Ohio State University, and Mr. L. O. Kunkel, recently a Research Fellow at the Garden and now Assistant in the Department of Botany at Columbia University, visited the Garden during August and September.

Dr. F. W. Pennell, of the University of Pennsylvania, spent several days at the Garden during the latter part of August. Dr. Pennell is pursuing monographic studies in the Scrophulariaceae and in this connection consulted the Garden herbarium. Mr. Bernard Mackensen, of San Antonio, Texas, who is interested in the cacti, also spent several days in the herbarium early in September studying some of Dr. George Engelmann's type specimens.

All genera of cycads are now represented in the Garden

doxa, a native of Natal. Another noteworthy addition to the cycad collection is *Microcycas calocoma,* a native of Western Cuba, presented to the Garden by the New York Botanical Garden. In its native haunts this tree attains a maximum height of twenty feet, and bears at its summit a magnificent crown of large pinnate leaves. In general its appearance is similar to that of the common "funeral," or "Sago palm" *(Cycas revoluta).*

The cotton field in the Herbaceous Tract, which was mentioned in the May BULLETIN, is now at its best. The plants are stout specimens, measuring up to five and one-half feet in height, and the miniature field presents perhaps as good a growth of cotton as can be found on good southern plantations. At the tips the mallow-like flowers may still be seen, and slightly below these the miniature bolls, at first hidden in the involucre, but soon enlarging and exceeding the latter. And lastly, near the ground, a few bolls have already opened, showing the mass of white cotton fibers within, curled up and attached to the oily seeds at the center.

STATISTICAL INFORMATION FOR AUGUST, 1913.

GARDEN ATTENDANCE:

Total number of visitors	18,613

PLANT ACCESSIONS:

Total number of plants donated	65

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	36
Total number of books and pamphlets donated	211

HERBARIUM ACCESSIONS:

By Exchange—	
University of Pennsylvania — Scrophulariaceae from the Atlantic and Gulf coastal plain	94
By Purchase—	
W. P. Carr—Phanerogams of Northwestern South Dakota, Fascicles I and II	100
Th. Oswald Wiegel — Plants of Kamerun, collected by Dr. G. Zenker, Cent. III	100
By Gift—	
C. Conzatti—Plants of Mexico	2
S. L. Thompson—*Hordeum jubatum* L. from Manitoba	1
R. M. Harper—Plants of Alabama and Arkansas	10

The Garden is open to the public Sundays until Nov. 30th from 2:00 P. M. until sunset. Week-days the year 'round from 8:00 A. M. until one-half hour after sunset. Admission Free.

Personally conducted trip through Garden every Saturday afternoon from May 1 to Nov. 1, starting from Main Gate at 3:00 P. M. Other trips may be arranged for by special appointment.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

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ARRIVAL OF THE TWO NEW PALMS AT THE GARDEN.

Missouri Botanical Garden Bulletin

Vol. I St. Louis, Mo., October, 1913 No. 10

TWO NEW PALMS.

The Missouri Botanical Garden is fortunate in receiving, through the generosity of Mr. D. S. Brown, two remarkably fine palms from his collection at Kirkwood. These plants have been in Mr. Brown's possession for a considerable number of years and as both of the giant specimens were touching the roof of the house in which they were growing, it became necessary to remove them to a taller structure in which their future growth might continue.

The central greenhouse of the new plant range recently completed at the Garden, is sixty-five feet in height at the center, and offers an ideal location for these plants. Arrangements were made for their removal from Brownhurst immediately after the offer from Mr. Brown was received. Two large rock wagons, an extra pair of wheels, roller trolleys, pulleys, jacks, etc., were necessary to assist in their transportation, it being quite an undertaking to successfully remove from a crowded greenhouse such delicate plants, weighing between one and two tons each.

The sugar palm *(Arenga saccharifera)* has a trunk measuring about six feet in height and one and one-half in diameter, and is thirty-one feet from the base of the trunk to the tip of the leaves. This is undoubtedly the largest sugar palm in cultivation in this country. The greatest care had to be taken to prevent the tender growing leaves from being broken, it being necessary to securely pack and fasten them to the main stem of the older leaves. This palm is a native of the Malucca and Philippine archipelagoes and is cultivated in Malucca, Siam and Cochin China, where it is known to the natives as "ejow" or "gomuti palm." It is one of the

large quantities is obtained from the trunks by splitting them open, scraping out the cellular portion and extracting the starch by washing. A very strong, black, stiff, horse-hair-like fibre from the base of the leaf stalk is used for cordage, ropes and brushes. The tree dies after flowering.

The Romanzoff palm *(Cocos Romanzoffiana)* is the larger of the two plants, measuring forty-five feet from the base of the trunk to the tip of the leaves. The trunk itself is thirty feet in height and one foot, three inches in diameter. Owing to the brittleness of this long trunk, it is necessary to support it with heavy timbers, which will be left on the plant until it has entirely recovered from any check received during removal.

Both plants arrived at the Garden without having received the slightest injury, and since it was less than twenty-four hours from the time the palms were removed from Brownhurst until they were permanently planted in the new palm house at the Garden, it is believed they will suffer no serious set-back.

A BOTANICAL SURVEY OF THE SOUTHWEST.

The conspicuous economic development of the Southwest is rapidly changing the character of the natural conditions in this part of the United States. The growing number of irrigation projects, the construction of levee and dike for the reclamation of arid and littoral lands result in the gradual giving way of the native vegetation to vast plantations, rice fields, truck patches and fruit farms, thus promoting enormously the agricultural interests, but at the same time permanently replacing the indigenous flora by cultivated plants. Accompanying these changes there is naturally a rapidly growing population and an increasing demand for a concise and reliable flora of the region concerned.

At the present time there is no publication which is sufficiently comprehensive to cover completely the entire Southwest; although certain parts of the region are either already provided with a working manual or at least have one in the course of publication, as for example, Coulter's *Flora of Western Texas,* and forthcoming floras of New Mexico and Arizona amply provide for the more arid and distinctly mountainous parts of the Southwest. Again, Dr. Small's admirable *Flora of the Southeastern United States* is of inestimable value in studying our Southern flora, but as the

Appalachian system and that of the Atlantic and Gulf coastal plain; and while its western geographical limits overlap a portion of the Southwest, yet the latter region is, to a large extent, extra-limital to Dr. Small's *Flora*. Hence this intermediate region, or that part of the Southwest included between the northern boundary of Missouri and Kansas on the north, the Mississippi River on the east, the Gulf of Mexico and the Rio Grande on the south, and in general the western boundary of Kansas, Oklahoma, northern Texas and the Pecos River on the west is greatly in need of a concise, convenient and authoritative manual.

The production of such a work naturally necessitates a thorough botanical survey of the plants in the field, and a detailed study of all available material in herbaria. The undertaking, however, is of such magnitude and scientific importance that it can only be prosecuted satisfactorily by an established institution like the Missouri Botanical Garden.

The collections of both dried and living plants in the Garden, since the early days of the institution, have been built up very largely of material from the southwestern part of the United States. The private herbarium of Dr. George Engelmann, consisting of over 90,000 specimens and acquired by the Garden about a quarter of a century ago, contained a very large proportion of Southwestern plants. To these have been added the private herbaria of several prominent botanists whose collections have been brought together from Missouri, Arkansas, Louisiana and other parts of the lower Mississippi Valley, thus giving a splendid representation of the native plants of this rather homogeneous floral region. In fact the Missouri Botanical Garden, more than any other establishment in the country, has been for many years the natural depository for plants secured on practically every expedition to the Southwest.

While the Garden herbarium is already unexcelled in its representation of the Southwestern flora, yet it is the duty of the institution to make its collections even more complete by exploring as thoroughly as possible certain portions of the south central states, particularly those parts which have been comparatively little worked botanically and whose flora is, consequently, least represented in the Garden herbarium, and finally to corellate the results of the survey in a manner that will render the information obtained available to the people of our region and to the scientific public in general.

By the sanction of the Board of Trustees, Mr. Ernest J. Palmer, an experienced collector, has been placed in the

work, having up to the present time secured several thousand excellent herbarium specimens. During the current autumnal season, Mr. Palmer's field work will be confined mainly to southwestern Missouri and to northwestern Arkansas; and in the spring it is planned to have him begin his collecting very early in the season and work gradually northward from southern Texas to Missouri, then, in order to secure flowering specimens, revisit the same localities from which he obtained this fall fruiting material. Successive seasons will be spent in different parts of the Southwest so that eventually the Garden's collections from the entire territory will be reasonably complete.

In consideration for a set of the woody plants obtained by Mr. Palmer, the Arnold Arboretum of Harvard University is generously coöperating with the Missouri Botanical Garden in the field work.

With the excellent representation of the Southwestern flora already on hand, supplemented by new material, it is confidently felt that after an intensive study of the plants in the herbarium and in the field, it will be possible to make a permanent record of the indigenous flora before its natural aspect is irrevocably altered and to produce a handbook which will be of service to the student and of value for reference to the specialist.

PITCHER PLANTS.

The pitcher plants, comprising about thirty species, belong to the genus Nepenthes, the only representative of the family Nepenthaceae. All are natives of tropical Asia, Madagascar, tropical Australia and especially the Malayan archipelago, being found near the seacoast in a climate of uniform temperature where, during a large part of the year, the air is thoroughly saturated with moisture.

The flowers of these plants are dioecious (the male and female flowers on separate plants), and not particularly noteworthy, being small and of greenish color, turning to dark brown. The leaves, however, are remarkable and are responsible for the classification of the nepenthes among the wonders of the vegetable kingdom. These are alternate, the prolonged midrib being spirally twisted like a tendril and

corrugated rim which serves three purposes, namely it strengthens the mouth and keeps it distended, it secretes nectar, and often develops into a funnel-shaped tube which projects into the pitcher, preventing the escape of any insect which may have entered. From the rim to the base of the pitcher, there usually extends a pathway, the sides of which are provided with long teeth-like hairs, resembling those found in the Venus fly trap. Until fully developed, the mouth of the pitcher is closed by means of a lid which later is permanently lifted and serves as a protection from rain. It is not true, as is popularly supposed, that the lid closes when an insect enters the pitcher.

The interior of the pitcher is covered with innumerable spherical glands which secrete, before the opening of the lid, a fluid comparable to the gastric juice of the stomach. Insects are attracted by the nectar on the under side of the lid and on the corrugated rim and usually enter the pitcher from which they seldom find it possible to escape. They are soon drowned in the liquid which afterwards partially digests them, thus rendering these plants just as truly carniverous as many animals. A plant of the nepenthes, "paradisæ" in the Garden collection recently captured several cockroaches, and two days later red ants were noticed climbing up the pitcher between the pathway of thorn-like hairs, many hundreds of them being ultimately consumed by the plant. The digestive fluid is said to be collected from the fresh pitchers by the natives of Borneo and used as a remedy for indigestion.

Cultivation and Garden Collection. — Members of the genus Nepenthes are difficult to grow satisfactorily, unless a special house is provided for their cultivation, and with the crowded state of the old greenhouses it was impossible to give them the special conditions necessary to bring them to perfection. With the removal of the small tropical ferns to the new plant range, it will be possible to put all the insectiverous plants, including the pitcher plants *(Nepenthes)*, trumpet-leaved pitcher plants *(Saracenia)*, Venus fly trap *(Dionaea)*, and sun-dews *(Drosera)* in one house. This will be provided with a large tank over which the plants will be suspended, thus providing the moist atmosphere so necessary to produce perfect specimens. Nepenthes should be grown in soil composed of equal parts of peat and sphagnum moss. The roots must always be kept moist and the leaves sprayed periodically throughout the day.

The Garden collection includes, besides *Nepenthes phyllamphora, N. Curtisii* and *N. Rafflesiana,* the following horticultural varieties: "Sir W. T. Dyer," "Balfouriana," "Dominii," "dicksoniana," "mixta," "intermedia," "Hainiensis," "paradisae," "chelsoni var. excellens," "Courtii," "atrosanguinea," "Mastersiana," "Hookerae," "Henryana" and "O'Brieniana." The latest hybrid, "Sir W. T. Dyer," was raised by crossing "dicksoniana" and "mixta," and when fully grown each pitcher holds a quart of water. The pitchers of the plants of this variety growing in the house at the present time hold about a pint.

OPENING OF THE NEW GREENHOUSES.

It is expected that the new range of greenhouses will be opened to the public about the middle of November. The exact date will be announced in the daily papers. It will, of course, require a considerable length of time for the large number of plants to become thoroughly established, and some of the planting effects desired cannot be obtained for a number of months, yet it is believed that from the first the houses will present a sufficiently attractive and interesting appearance to warrant a visit.

A large collection of chrysanthemums with the usual number of varieties and some striking new forms will be exhibited, thus inaugurating the monthly flower shows which will be maintained throughout the winter and spring.

NOTES.

Mrs. Katherine Brandegee, of Berkley, California, spent a week at the Garden in September consulting the specimens of Onograceae in the herbarium.

Twenty-five members of the botany class of Soldan High School, under the direction of Mr. G. W. Bishop, visited the Garden October 16th.

Mr. Carleton R. Ball, in charge of Western Wheat Investigations of the United States Department of Agriculture, visited the Garden October 16th.

A medium-sized century plant is in full bloom in the agave house. It has a flower spike fourteen feet high, bearing numerous yellowish green flowers with light brown anthers.

Dr. J. N. Rose, research associate in the Carnegie Insti-

On October 21, Dr. George T. Moore, Director of the Garden, delivered an address before the science section of the Wednesday Club of St. Louis. The subject of Dr. Moore's address was: "Conservation of the Soil."

On September 26 the St. Louis Branch of the American Pharmaceutical Association held an informal meeting in the Garden, and visited the plant houses and out-door collections. The medicinal and rose gardens and the herbaceous tract especially interested the members of the association.

Mr. J. Hollister Tull, Agriculturist for the Kansas City Southern Railroad, and Mr. Walter Nehrling, of the Charleston, Ill., Normal School, visited the Garden during October. Both Mr. Tull and Mr. Nehrling are former students of the Garden.

STATISTICAL INFORMATION FOR SEPTEMBER, 1913.

Garden Attendance:	
Total number of visitors	11,769
Seed Exchange:	
Total number of packets distributed	360
Total number of packets received	15
Plant Accessions:	
Total number of plants donated	735
Library Accessions:	
Total number of books and pamphlets bought	18
Total number of books and pamphlets donated	112
Herbarium Accessions:	
By Purchase—	
A. J. Grout—North American Musci Pleurocarpi	28
By Gift—	
H. P. Chandler—Plants of Texas	54
H. S. Conard—Plants of Iowa	5
B. M. Duggar—Plants of Georgia	50
J. A. Drushel—Plants of Texas	9
G. R. Hill—Plants of Utah	2
A. M. Huger—*Epilobium angustifolium* L. from North Carolina	1
Minnie E. Nash—*Prunus caroliniana* Ait. from Louisiana	1
H. von Schrenk—Fungi from Oregon and New Jersey	2
Total	152

The Garden is open to the public Sundays until Nov. 30th from 2:00 P. M. until sunset. Week-days the year 'round from 8:00 A. M. until one-half hour after sunset. Admission Free.

Personally conducted trip through Garden every Saturday afternoon from May 1 to Nov. 1, starting from Main Gate at 3:00 P. M. Other trips may be arranged for by special appointment.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

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Assistant to the Director.
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In Charge of Main Garden.

MAX SCHILLER,
In Charge of New Plant Range.

Missouri Botanical Garden Bulletin

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ST. LOUIS, MO.
1913

BOARD OF TRUSTEES
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THE ORIGINAL MEMBERS WERE DESIGNATED IN MR. SHAW'S WILL, AND THE BOARD SO CONSTITUTED, EXCLUSIVE OF THE *EX-OFFICIO* MEMBERS, IS SELF-PERPETUATING.

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THE NEW CONSERVATORIES.

The new conservatories which were described in the February number of the BULLETIN were completed in June of the present year and, of their type, comprise the largest group of greenhouses in this country. The range consists of five houses, the largest, occupying the central position, being the palm house, measuring 90 by 110 feet and 65 feet in height, flanked on the north by the fern house and on the south by the economic house, each of which measures 45 by 95 feet and 50 feet in height. Extending west at right angles to the latter are the north and south floral display houses, each 33 by 145 feet by 40 feet in height.

After the actual work of construction was completed the preparation of the houses for final planting was begun. Among the first tasks was the installation of a thorough subsoil drainage system to permanently prevent the accumulation of soil water in the houses and render the soil most favorable for plant growth. Such a system was especially necessary because of the landscape treatment to be referred to in more detail later.

The filling of the greenhouses with suitable soil was likewise deferred until after the superstructure was completed. This was done in order to prevent the firm packing of the soil and the admixture with it of glass fragments and other debris incident to the work of construction. In placing the fill the general planting plan was taken into consideration. Heretofore, most plants in the Garden have been grown in pots and tubs because of the inadequate space available in the old houses. Plants grown under these conditions, as may be expected, do not attain their best development and frequently fail to reveal the real beauty of the species. The abundance

and to meet these requirements ample provision was made in the fill.

When the construction work was completed the condition of the front range was such that a fill of four feet and in some places in the fern house of as much as ten feet was necessary. While the deeper places in the fern house were, so far as possible, utilized in the establishment of the valley and pools, it is safe to say that an average fill of fully four feet was necessary throughout the front range. The entire fill, amounting to about 3,000 yards, was constructed out of rich top soil. Before work was begun on the new range, the surface soil covering the area to be occupied by the new conservatory was stripped off and piled to one side. Out of this reserve about one-third of the fill was constructed. The remainder was obtained from a large compost heap which has been accumulating in the Garden for a number of years and which furnished an ideal medium for plant growth made up, as it was, of rich soil and decomposed vegetable matter. To insure a constant future supply of certain essential plant foods, raw crushed bone was mixed with the soil as the latter was brought into the houses. Soil cars and a narrow gauge tramway laid directly to the soil piles greatly facilitated the filling of the houses.

As soon as the fill reached the top of the piers supporting the steam coils, a four-inch concrete retaining wall was built against the pipes and extending slightly above them. Against this wall the soil was banked, resulting in almost the complete concealment of both the coils and the wall and preventing at the same time the excessive drying of the soil in the immediate vicinity.

In conservatories in which the plants are displayed on benches and in which the planting is of the usual formal type, the walks are generally fixed in their position with almost the same permanence as the building itself. In the front range of the new conservatory, however, the planting plan adopted marks a decided departure, the desired effect being that of an informal landscape throughout. The walks, therefore, have been located in such a manner as to present to the visitor the greatest number of pleasing and picturesque bits of landscape and at the same time to render all of the plants individually as accessible as possible. The paths are made with a cinder foundation and a light surface dressing of sand. With this type of construction, the position of the walks can be readily

PATH IN THE PALM HOUSE.

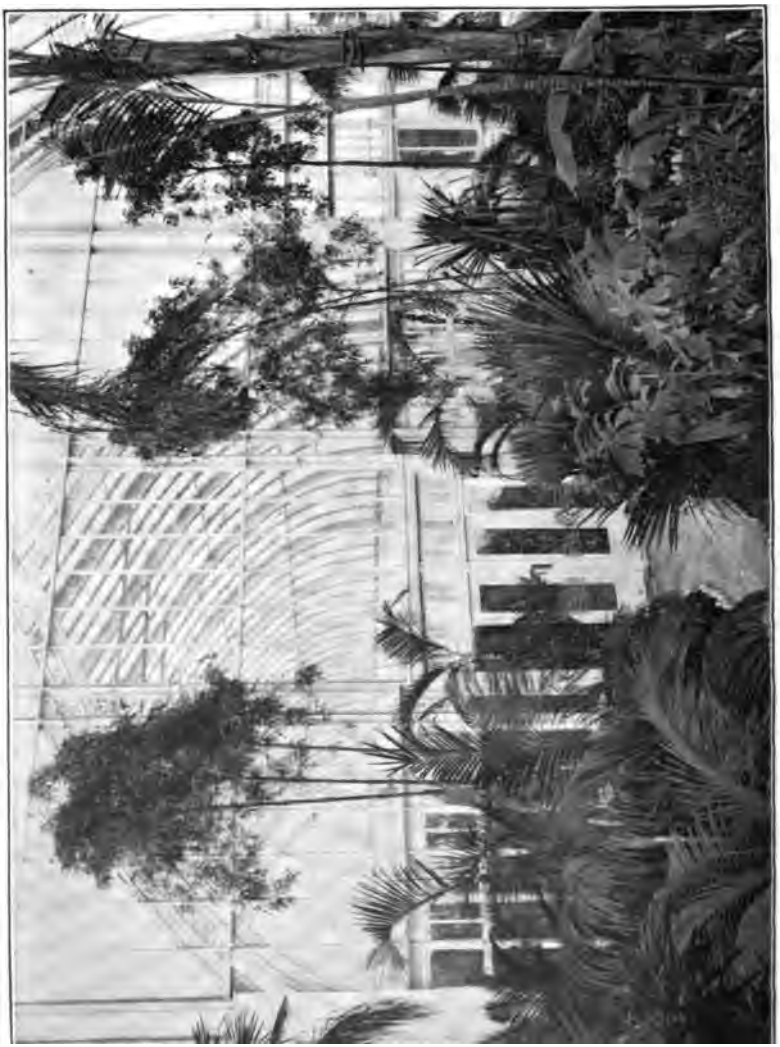
The Palm House.—The large amount of free overhead space in this house permits of a treatment of the plantations that is unique. In most palm houses it has been necessary to place all large plants in the central space and confine the walks to the outside boundaries. This produces the effect of a large central bed the individual plants of which are more and more inaccessible the farther they are removed from the walks. In the conservatory under consideration, however, such an arrangement has been carefully avoided. In the palm house there are four entrances, one on each side, connected by walks in such a manner as to shut off a direct view from door to door. Paths along, the axes of the house have been dispensed with, and in their place pleasing vistas, produced by leaving the plantations open, and enhanced by a green flooring of selaginella, have been provided. Along the walks, on both sides, the largest plants have been placed and in such close proximity to them that they are readily seen. While not all of the specimens in the house are palms, the latter predominate and the general effect produced is that of a palm grove.

On each side of the east entrance as one enters, are fine specimens of the rattan cane *(Rhapis flabelliformis)* banked in against the entrance; a similar pair decorates the west entrance. Turning to the right and following the path around the house an interesting succession of plants appears as follows: A large specimen of fortune's palm *(Trachycarpus excelsus)* a tree which, in England, is considered hardy. Behind it and almost touching the roof of the house is the tallest plant in the conservatory, a specimen of the Romanzoff palm *(Cocos Romanzoffiana)*. This was formerly in the old front house where, owing to the lack of head space, it had been sunk in a pit about twelve feet deep. Its removal was a difficult task, because of the long, brittle and slender trunk and even now it is necessary to support it by means of wires fastened to the stem and to the sides of the house. In front of this specimen is a large phoenix, a species of date palm, which arches over the walk to meet a splendid specimen of the royal wine palm *(Oreodoxa regia)*. The latter is a familiar sight in the southern states, especially in Florida. Behind the royal palm stands a small but interesting specimen of the cabbage palm *(Livistona australis)*, sometimes called the fan palm, and a little beyond the Chinese fan palm *(Livistona chinensis)*. The latter form will attract consider-

the pine group it has been given a place in the palm house on account of its interesting character—the leaves being broad and not needle-like as is usually the case among the pines. Opposite the large Chinese fan palm is a good specimen of the southern palmetto *(Sabal Palmetto)*. On each side of the north entrance are large specimens of the common bamboo *(Bambusa arundinacea)*. These are of the fishing pole variety and when thoroughly established in the free soil will doubtless be very attractive plants. The bamboo grows rapidly and under the conditions realized in the palm house they will probably be the first to reach the roof. The sides of the entrance to the fern house are further marked by two good plants of the Pinang palm *(Chrysalidocarpus lutescens)*. These are expected to arch immediately over the doorway, whereas the bamboos will arch considerably higher up.

Turning westward, there stands on the left a small but interesting specimen of the Australian feather palm *(Ptychosperma Macarthurii)* and also a single well-grown plant of *Licuala grandis*—the only specimen of this species in the Garden. Behind them is another palmetto and across the walk on the right a cocoanut palm *(Cocos nucifera)* and an additional Pinang palm *(Chrysalidocarpus lutescens)*. In the corner has been placed the largest specimen of fortune's palm *(Trachycarpus excelsus)* in the house. A large screw pine *(Pandanus utilis)* and a well-grown flat-leaf palm *(Howea Forsteriana)* complete the plantation. Across the walk again and near the center of the house is the specimen of *Cocos Romanzoffiana* described in a recent number of the BULLETIN, as coming from Mr. Brown's collection at Kirkwood, Missouri. The full beauty of this magnificent plant will not be apparent until the new leaves begin to come out. In front of this giant are specimens of the spiny fish-tail palm *(Martinezia caryotaefolia)*, blue palm *(Erythea armata)*, with slate-blue leaves, Pinang palm, spiny date palm *(Archontophoenix crinita)* and a very large golden pandanus *(Pandanus Sanderi)*.

Beyond the west entrance on the left are good plants of the curly palm *(Howea Belmoreana)* and the Chinese fan palm *(Livistona chinensis)* together with a tall avenue palm *(Cocos plumosa)*. The latter species is probably used more than any other plant as a street tree in the tropics. A large cocoanut palm *(Cocos nucifera)* stands to the south of the avenue palm with another pandanus and a fortune's palm in front. On the right side of the walk is a large Chinese fan palm *(Livistona chinensis)* and on the left near the center of



CORNER IN THE PALM HOUSE WITH FERN HOUSE IN THE DISTANCE.

of *Medinilla magnifica* which, while not a palm, has been given a place in the palm house, and close by a good specimen of the bungalow palm *(Archontophoenix Cunninghamii)*. A large *Pandanus Veitchi* or Veitch's pandanus adorns the far corner. On the left again and balancing a similar specimen on the right is a fortune's palm *(Trachycarpus excelsus)* and in the central group near the entrance a broom palm *(Chamaerops humilis)*. Good plants of the Pinang palm mark the sides of the south entrance.

Turning to the east, a single plant of *Hydriastele Wendlandiana* marks the right side with the Illawara palm *(Seaforthia elegans)* directly opposite. A weeping palm *(Washingtonia filifera)* and the Garden's largest specimen of screw pine *(Pandanus utilis)* have been placed on the right side of the path a little farther on and opposite them the oil palm *(Attalea speciosa)* and behind this the most attractive single specimen in the house, the sugar palm *(Arenga saccharifera)*, referred to in detail in a former number of the BULLETIN. Nearing the east entrance one finds on the right a thorny-stemmed palm *(Acanthorhiza aculeata)* together with a good specimen of date palm *(Phoenix dactylifera)*; and on the left a plant of *Phoenix canariensis*, one of the date palms, and finally a good bungalow palm *(Archontophoenix Cunninghamii)*.

This enumeration of plants by no means includes all of the species represented in the palm house, but it will serve to give some idea of the collection which has been brought together here as well as of its arrangement. In addition there are present a large number of smaller palms which are worthy of attention. This is especially true of some of the small California palms and the dwarf palm *(Phoenix Roebliniana)*. Some of these specimens, at present small, will be the future giants of the house as, for example, the Cohune oil palm *(Attalea cohune)*. At present its leaves are only four feet long, but when the plant is full grown, they frequently attain a length of from forty to fifty feet. The future growth of the palms has been taken into consideration in the arrangement of the plants, and this fact explains any bareness or gaps which may at present be apparent.

The Economic House.—In this house has been brought together a portion of the Garden's collections of plants which are of interest primarily from an economic standpoint. Because of the large number of specimens, and their relatively small size, it is naturally more difficult to display all of them [illegible] However, little difficulty will be experienced

individual plants, indicating the groups by large markers, and clearly labelling every specimen.

The center of the house is occupied by a large oval bed flanked by walks outside of which other sections graded up in amphitheatre fashion take up the remaining available space. The central bed is planted with tropical fruits and notice will be given in the BULLETIN as specimens in this collection come into bearing from time to time. The side sections are planted with special collections among which plants yielding fibers, perfumes, medicines, condiments and the like may be mentioned.

As previously stated, this house does not contain all of the economic plants, tropical or otherwise, in the Garden collections. Visitors interested in species not represented in the economic house but which are in the Garden, may obtain access to them by referring to the man in charge.

The Fern House.—The landscape work in the fern house is very different from that in the palm and economic houses. This finds its explanation in the character of the plants displayed in this conservatory. Ferns in general are of small stature and much of their charm lies in the beauty of detail of their foliage. It is at once apparent, therefore, that in the fern house careful attention had to be given to the arrangement of walks and plantations so as to enable as many of the plants as possible to be seen at close range. Furthermore, the symmetry of fern foliage can, in most cases, be fully appreciated only when viewed from above—a fact which also had to be taken into consideration in planning the landscape.

To meet both of these demands, the general plan of a deep central valley with steep, sloping sides running almost the full length of the house was adopted. Beginning at the north exit of the palm house a walk leading along the crest of the east side enables the visitor to view from above practically all of the ferns clothing the slopes and skirting the brook which winds through the bottom of the valley. At the north end of the house the path circles the end of, and descends to the bottom of the valley, returning along the bank of the brook and bringing the visitor face to face with the plants which were seen from above on the crest path. Having returned to the south end of the house, the brook path enters a stone grotto situated directly below the starting point of the crest path and leaves it again on the opposite side to mount by a series of stone steps to the level of the upper walk and there to join it. Plate 24 presents a view taken from the

VIEW IN THE FERN HOUSE.

bridge spans a small canyon in front of the grotto and marks the beginning of the crest path.

Entering from the palm house the visitor first comes out on a sort of platform—the roof of the grotto—from which a general survey of the house is obtained. In crossing the bridge the waterfall emerging from the canyon wall is seen on the right with a small pool directly below whence the brook takes its origin. The canyon and outer grotto walls are already covered with various ferns, among which the small, crawling fern *Adiantum caudatum* is especially noticeable. In time the walls on the interior of the grotto will be covered with plants which thrive in the very subdued light which prevails there. Just across the bridge and on the left side stands a large specimen of the turnip fern *(Angiopteris evecta)*, and at intervals along the brook smaller, but equally striking plants of the bird's nest fern *(Asplenium nidus)*. At the north end of the valley are several good specimens of *Cibotium Schiedei* which in a few years will be among the most attractive ferns in the house. A few large tree ferns dot the slopes here and there and smaller alsophilas are scattered throughout and will be much in evidence when they become thoroughly established in their new location.

The ferns already mentioned are a few of the more striking forms which stand out prominently above the countless numbers of smaller plants which have not been referred to but which cover every foot of the intervening spaces. Any bare places which exist will be quickly obliterated by the growth of the small plants occupying them now. Fern baskets will be hung in various places in the house as soon as suitable ones can be prepared, and vines and other climbing plants will add much to the attractiveness of this house.

A NEW FOLIAGE PLANT.

In March, 1912, the Garden received from the Bureau of Agriculture at Manila, Philippine Islands, seeds of the native *Ficus pseudopalma*. This plant was first described in 1837, by Blanco, in his "Flora of the Philippines" (Fl. Filip. Ed. I., 680; Ed. II., 473). In its native habitat it grows to be a small tree, from 18 to 21 feet high, rarely branching, with lanceolate linear leaves from 1 to 1½ feet long, dark green in color, the peculiar fruits being produced in the axils of the leaves. As the plant grows the leaves are shed, with the exception of a number at the top making the crown appear not unlike a bird's nest fern.

high. Their importance as decorative plants was early recognized, and it is surprising that they have not sooner attracted more general attention. The propagation is not difficult as the plant is readily grown from seeds or cuttings.

In the Garden it has been used in the green houses as a background, where it effectively replaces pandanus, dracaenas, etc. During the past summer a bed, planted outside and edged with achalypha, furnished a new and interesting effect. The plants require considerable water and grow luxuriantly in partial shade, but it is probable that they will do as well in full sunlight. During the coming season this ficus will be used in the main garden as a point plant instead of the usual pandanus or dracaena.

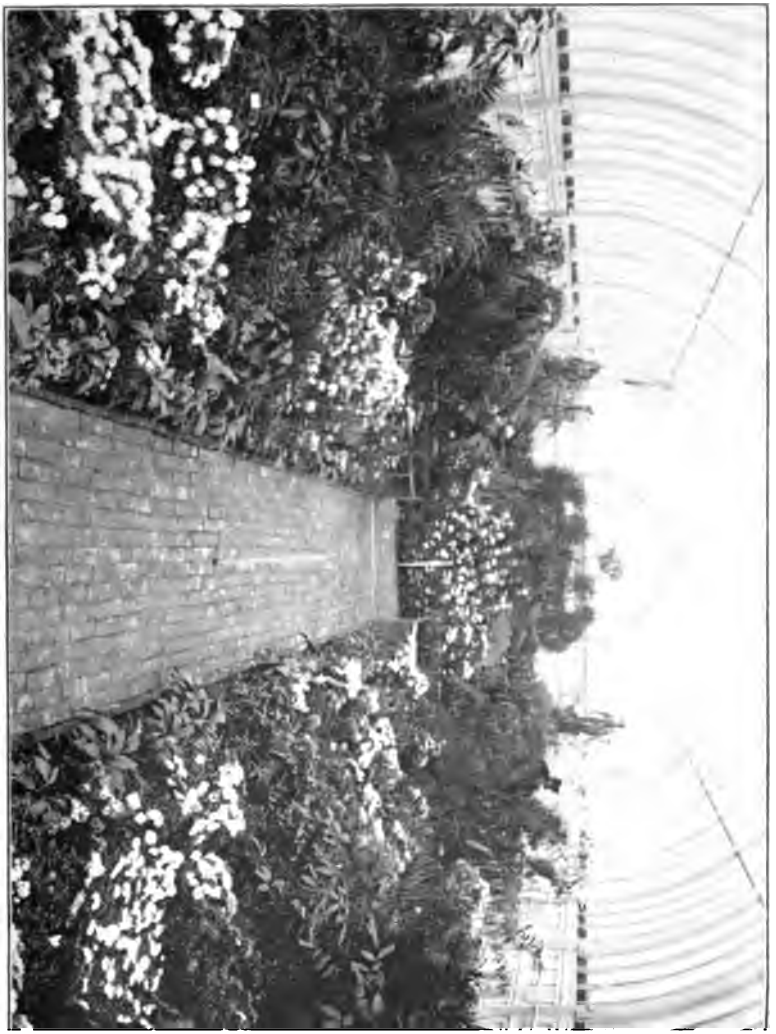
Ficus pseudopalma (see plate 25), stands erect on a strong stem, has a well-shaped crown and possesses all the attributes of a foliage plant for home decoration as well as for outdoor planting.

THE CHRYSANTHEMUM DISPLAY.

The two floral display houses have both been given up to the chrysanthemums. While the number of plants does not exceed 1,600, being considerably less than in former years, they are in general larger and much space is devoted to the special forms. Instead of crowding the entire display into one house, as was necessary last year, it has seemed best to distribute it through both houses, thereby providing ample space for each individual plant. This arrangement also permits of the frequent use of masses of green foliage between the groups to lend a certain refinement which chrysanthemums alone do not possess.

The treatment in the two houses is, in general, the same (see plate 26). The middle of the first section is provided with a broad walk, the plants being banked in large masses on each side. In the second section the plants occupy both the center and the stages along the outside walk. Palms, cycads and other decorative plants are used in large quantities for backgrounds.

On the opening Sunday 10,000 visitors viewed the chrysanthemums; on the second Sunday, 18,347, and during the first



ONE OF THE FLORAL DISPLAY HOUSES CONTAINING CHRYSANTHEMUMS.

Mayor Newton Baker, of Cleveland, and party, visited the Garden on November 20th, principally for the purpose of inspecting the new conservatories.

Dr. C. J. Humphrey of the University of Wisconsin, has spent several weeks at the Garden in a critical study of certain sections of the mycological herbarium.

Dr. David Fairchild, in charge of foreign plant introduction in the United States Department of Agriculture, accompanied by Mrs. Fairchild, recently visited the Garden.

At the October meeting of the St. Louis Chapter of the American Institute of Architects, Dr. H. von Schrenk, honorary pathologist to the Garden, delivered an address on "Modern Uses of Timber."

About seventy delegates to the meeting of the State Teachers' Association of Missouri, recently held in St. Louis, visited the Garden under the leadership of Professor Drushel of the Teachers' College.

An event of interest to visitors to the Garden was the ceremony held on November 1st, to celebrate the inauguration of work to abolish the Tower Grove grade crossing at Tower Grove avenue and the railroad tracks.

Dr. Aven Nelson, of the University of Wyoming, Dr. Edward O. Sisson, Commissioner of Education of Idaho, and Mr. A. L. Bauwens, of Brussels, Belgium, General Inspector of Agriculture, visited the Garden during the present month.

On October 30, Dr. Harvey Johnston and Mr. Henry Tryon of the Prickly Pear (traveling) Commission, of Queensland, Australia, visited the Garden. The commission is endeavoring to find means of eradicating or utilizing species of prickly pear which at the present time are considered pests in Australia.

The following changes have been made in the old conservatories: The former bromeliad house has been converted into a house for epiphytic orchids and marantas together with a few other attractive foliage plants. An exceptionally large vanilla plant is the most prominent feature. The former East India house has been replanted so as to embrace the aroid collection in the Garden and the old fern dome is now planted with bananas.

A noteworthy improvement in the Garden is the completion of about 3,200 feet of a five-foot iron fence along Magnolia

STATISTICAL INFORMATION FOR OCTOBER, 1913.

GARDEN ATTENDANCE:	
Total number of visitors	14,290
SEED EXCHANGE:	
Total number of packets received	12
PLANT ACCESSIONS:	
Total number of plants donated	5
Total number of plants received in exchange	291
PLANT DISTRIBUTION:	
Total number of plants distributed	1,120
LIBRARY ACCESSIONS:	
Total number of books and pamphlets bought	38
Total number of books and pamphlets donated	75
HERBARIUM ACCESSIONS:	
By Purchase—	
W. E. Broadway—Plants of Tobago	100
H. Sydow—"Fungi exotici exsiccati" Fasc. III, IV	100
R. Friedlander—Sydow's "Mycotheca germanica" Fasc. XXIV.	50
T. Weigel—Buchtien's Plants of Bolivia	150
J. M. Macoun—Plants of Canada	391
By Gift—	
I. W. Clokey—Plants of Illinois, Canada and Mexico	172
T. D. A. Cockerell— Seeds of *Oenothera Cockerelli* Bart. and DeVries, and *O. Hewetti* Cockerell	2
W. J. O'Carroll—*Epidendrum paniculatum* Ruiz and Pav.	1
C. C. Deam—*Quercus macrocarpa* Michx. var. *olivaeformis* (Michx.f.) Gray from Indiana	1
J. A. Drushel—Plants of Maine, Illinois and Missouri	8
J. M. Greenman—Plants of Illinois and Missouri	17
A. A. Heller—Plants of Nevada	4
Mrs. O. M. More—Plants of England	16
J. A. Nieuwland—Plants of Indiana	237
C. R. Orcutt—Plants of Mexico	277
By Exchange—	
Field Museum of Natural History—Photographs of type specimens	50
Aven Nelson—Plants of Idaho, Colorado, Utah and Nevada	698
Total	2,274

The Garden is open to the public week days the year 'round from

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Missouri Botanical Garden Bulletin

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ST. LOUIS, MO.

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[illegible]AM, Secretary.

SOUTH END OF ORCHID HOUSE.
SHOWING PLANTS IN BLOOM THIS MONTH.

Missouri Botanical Garden Bulletin

Vol. I St. Louis, Mo., December, 1913 No. 12

ORCHIDS.

The orchids undoubtedly constitute one of the most interesting groups of flowering plants, both botanically and commercially speaking. Their foliage, unlike that of the palms, or of their nearer allies, the cannas and bananas, is not particularly striking; their flowers, however, often curiously and grotesquely shaped, and ranging in color from the deepest purple to the purest white, are full of interest and early attracted attention to this rather unique assemblage of plants.

The Collecting of Orchids. Tropical orchids are being extensively collected at the present time by various commercial establishments, especially the well-known cattleyas of South America and dendrobiums and cypripediums of the Indo-Malayan region. The first two mentioned endure the hardships of transportation much better than the last, owing to their contracted and thickened stems, in which quantities of food are stored. In their native haunts these storage bulbs supply the plants with nourishment during the dry season and doubtless serve in a similar capacity during the long journeys to temperate zone greenhouses.

The accounts of stirring experiences of orchid collectors, or so-called "hunters," occasionally appearing in popular magazines are largely without foundation. With the exception of the possible contraction of malarial fever, there is little more danger involved in collecting orchids than in collecting native plants in the Ozark region of Missouri. After selecting a favorable point as headquarters in a region abounding in orchids, the collector proceeds to hire natives,

of *Cattleya Trianaei* has been reached. The actual work of collecting is done by the natives who climb the trees, to the trunks and branches of which these orchids are securely attached. The plants are pulled off, packed on the mules and taken to headquarters. Here they are graded according to size and variety, packed dry in boxes or crates and sent to the nearest seaport for transportation. Several months usually elapse from the time the orchids are first collected until they reach their final destination.

Geographical Distribution. Orchids are very widely distributed, being represented in the temperate, sub-tropical and tropical floras. The epiphytic forms are confined to the warmer countries, whereas the terrestrial and saprophytic species inhabit both temperate and tropical regions. *Cypripedium pubescens,* one of the lady's slipper orchids and representative of the terrestrial species, grows in Missouri, in fact as near St. Louis as Allenton. It is one of the so-called "ground" orchids that are found in the temperate regions of North America and Europe, inhabiting both dry and swampy regions. Of these the most interesting European form is the bee orchid, *Ophrys apifera,* found growing on chalk hills in exposed positions.

The epiphytes—those species found growing upon trees—first make their appearance in Florida, increasing in luxuriance southward. Their greatest development is reached in South America, where the well-known cattleyas, laelias, odontoglossums, oncidiums, miltonias and representatives of numerous other genera are at home. Of these the first two are found in three rather distinct regions,—the extreme northern portion of Mexico and Guatemala, the northern part of the South American Continent extending from the Western Cordilleras of New Granada to British Guiana, and lastly the maritime province of southeastern Brazil. Plants of the *Cattleya labiata* group, remarkable for the large size and beauty of their flowers, are native of the Colombia-Guiana region. Among these are *C. Trianaei* and the well-known varieties, "Mossiae," "Gaskelliana" and "Percivalliana," etc. One of the most widely distributed genera is Oncidium, representatives of which are found in the West

The Indo-Malayan region is almost equally prolific in forms and likewise comprises a wide area, affording such genera as Dendrobium, Cypripedium, Coelogyne, Vanda, Cymbidium Calanthe, etc. Of these the representatives of the genus Dendrobium show perhaps the widest distribution, more than four hundred species being scattered over the islands of the Malayan Archipelago and the western coast of Australia and extending to the Himalayan Mountains, in Burma, with finally some twenty-five species inhabiting the southwest portion of India and Ceylon. The richest district extends from the Nepaulese Himalayas down to lower Burma. In this region the plants are subjected to extreme heat, accompanied by an abundance of moisture throughout the greater part of the year. This is due to the enormous amount of water vapor which ascends from the Bay of Bengal and drifts towards the mountains where it is precipitated in the lower valleys, on coming in contact with the higher and colder altitudes. During the rainy season the plants make their growth in the form of a rod-like pseudo-bulb or elongated stem, varying in length from a few inches to six feet, according to the species. The dry season is comparatively short, varying according to the locality but usually lasting from the middle of October to the middle of March. During this period the plants assume a deciduous habit but are clothed with flowers which are produced, in most cases, in pairs from the nodes of the stems. The moth orchid, a representative of the genus Phalaenopsis, flowering specimens of which have frequently attracted attention in the Garden, is widely distributed over the islands of the Malayan Archipelago.

The orchid region of Africa extends from Ashantee on the west coast, through Sierra Leone to the Congo Free State and British Central Africa, and to the Comoro Islands and Madagascar. While the number of genera represented in this region is small, as compared to the number found in South America and Indo-Malaya, nevertheless such interesting genera as Angraecum, Listrostachys, Lissochilus, Bulbophyllum, Ansellia, etc., are found; one small genus of terrestrial orchids, Disa, is confined to the table mountains of Cape Colony.

were imperfect as was the knowledge of the natural habits of the plants. Epiphytic orchids, for instance, were treated in the same manner as terrestrial ones, all being planted in ordinary soil. Furthermore, the resting and growing periods of these plants were not appreciated. One of the first tropical orchids established under cultivation was the vanilla, an account of which was published in Miller's Dictionary of Gardening, in 1768. This relatively early success is doubtless due to the fact that the vanilla plant thrives in ordinary soil, provided ample heat and moisture are supplied. In 1778 *Phaius grandifolius,* a terrestrial orchid commonly called the nun orchid, was introduced from China. In 1794, Kew Botanic Gardens recorded fifteen species of epiphytic orchids, grown in "very great heat with fragments of half rotten bark at their roots." The favorite growing medium at the present period is osmunda fibre and sphagnum moss. The former, composed of the underground stems and roots of the osmunda fern, is extensively collected in the eastern states, whence it is shipped to Europe in large quantities. The first introduction of the well-known genus Cattleya was *C. labiata,* a specimen of which was sent to Mr. William Cattley, in honor of whom Dr. Lindley named the genus, of Barnet, England, about 1818. From this period on the introduction and commercial growing of orchids has progressed rapidly until at the present time both industries have assumed considerable proportions.

Mimicry. The resemblances of orchid flowers to members of the animal world, are, in some cases, rather remarkable. The dove orchid, or "Holy Ghost orchid" *(Peristeria elata),* a native of Panama, was named by the early Spanish settlers "El Espiritu Santa," meaning Holy Ghost orchid. The pure white flower with its column and beaked anther, combined with the ascending side lobes, representing the wings, strikingly resembles a dove. *Oncidium Papilio,* a native of South America, is easily recognized as the butterfly orchid, the antennae being represented by the thread-like sepals, whereas the wings find their counterpart in the large petals, including the labellum. The reddish-brown and yellow mottling of the corolla adds to the resemblance. The moth orchid

brachiata), with its attenuated sepals and petals, is not inappropriately named.

The common slipper orchid, a member of the genus Cypripedium, is perhaps the most commonly known orchid. Several tropical species are even more interesting than our native varieties, because in these the laces are furnished in the form of attenuated petals, measuring, in some cases, three feet in length. This is especially true in *Cypripedium caudatum*. The cricket orchid *(Coryanthes macrantha)*, a native of the West Indies, possesses a concave labellum into which two glands secrete nectar which drops down and keeps the bucket filled. The cow-horn orchid *(Schomburgkia tibicinis)* of Honduras, has hollow and tapering pseudo-bulbs which resemble a cow's horn. The point of particular interest, however, is that in Honduras certain ants make their homes in these hollow stems, entering them by means of an opening provided near the base. It has been observed that the specimen in the Garden collection is at times inhabited by the small black ants which frequent greenhouses and on several occasions, when the plant has been disturbed, the ants have been seen busy carrying their eggs out from the base of the pseudo-bulb.

Pollination. Orchids, with few exceptions, rely on insects for their pollination. The pollen is not powdery as is that of a lily, and, consequently, cannot be blown about by the wind to other flowers. On the contrary, it is produced in several compact masses, each attached separately by a caudicle to a central viscid disc. These masses are enclosed by a pollen cap each mass having a separate chamber. The pollen may be removed by raising the pollen cap attached by the rostellum or beak-like appendage; the latter is readily seen in the dove orchid, or the bird's bill orchid, the rostellum in both cases representing the bill or beak.

The particular insect which effects pollination in the different species varies with the flower, owing to the peculiar shapes and modifications of the third petal or lip. The latter is exceedingly variable, many of the striking differences between orchid flowers being due to variations and modifications of this part. In *Bulbophyllum fuscum*, the lip is tongue shaped and only about one-fifth of an inch long.

anthes, as previously stated, the lip is in the shape of a bucket and in *Catasetum maculatum,* the lip is hooded, whence its name monk's hood orchid. In the latter species the lip is at the top of the flower and this is in reality its correct position. The usual placement of the labellum at the bottom, as in Cattleya, is brought about by a twisting of the ovary in the early stages of development.

Insects do not visit orchid flowers for the purpose of pollinating them, but rather to collect the nectar which is stored in the glands or to feed upon the succulent petals and sepals. To effect an entrance into the flower, the visiting insect must traverse a rather definitely prescribed pathway, which is arranged in such a manner that pollination is almost certainly brought about by the visitor. The monk's hood orchid shows perhaps the most remarkable adaptations for insect pollination. The staminate and pistillate flowers are produced on separate individuals, the flowers being so different in shape that the two kinds of plants were at first erroneously described as separate species. No nectar glands are present in these flowers, the fleshy hood alone serving as an attraction for certain gnawing insects. On the interior of the lip and situated near the posterior portion of the latter, are two sensitive antennae or "triggers," which are indirectly connected to the pollen masses. The caudicle, which attaches the latter to the viscid disc, fits over the slightly rounded rostellum. While feeding on the labellum, the insect is almost certain to come into contact with the "trigger," thus causing the thin membranaceous caudicle to rupture spontaneously, thereby forcibly ejecting the two large pollen masses. The viscid disc adhering to the latter serves to attach the masses to the insect's back. When an insect so charged with pollen visits a pistillate flower, the masses are brought into contact with the stigmatic surface and pollination is effected.

The slipper orchid belonging to the genus Cypripedium, differs from the preceding form in that it possesses two fertile stamens instead of one. The insect readily enters through the large opening at the top of the slipper and feeds upon the nectar secreted at the base of the interior of the lip. When the visitor attempts to leave the flower, however, it finds it impossible to escape by the way it entered, because [illegible] smooth that it cannot gain a [illegible] The only other [illegible] above

entrapped insect. In forcing its way out of either of these small openings, however, it comes into contact with the sticky pollen masses which finally become firmly attached to its back. In the next flower visited the same process is repeated but in its outward journey the insect rubs its back against the stigmatic surface and deposits the pollen masses upon it, thus bringing about pollination.

The pollination of species of Cattleya in the Garden collection by native bumblebees has been observed several times. On one occasion the bee was seen to traverse the base of the sepals and petals in close proximity to the nectar gland, but it seemed unable, at first, to find the proper avenue of entrance. After a time, however, it entered the funnel-shaped lip down whose long tube it pushed its way finally reaching the nectar gland at the base of the labellum. Its next move was interesting. Finding it impossible to turn around, it backed out, the lip acting as a spring in keeping the back of the bee close to the column. In passing the beaked rostellum, the four pollen masses were ejected and securely fastened to the bee's thorax. While the bee was captured at this stage and photographed, and subsequently kept as a specimen, there can be little doubt that the adhering pollen would have been deposited upon the stigmatic surface of the next flower visited.

The few cases cited make it apparent that orchid flowers not only depend almost exclusively upon insects for their pollination, but also that they are so constituted as to insure cross-pollination in the great majority of cases.

Evolution of Hybrids. There are two groups of hybrid orchids under cultivation at the present time, the natural hybrids, resulting from insect cross-pollination among indigenous species, and garden hybrids, produced by artificial cross-pollination. While comparatively few of the former have been produced, the number of present day garden hybrids is extremely large, especially among the cypripediums. The development and growing of hybrids is at present being carried on extensively by the large commercial establishments.

The first authentic hybrid was raised by Mr. Dominy, of

ning, the cypripediums were almost exclusively used in hybridization; but at present the greatest activity exists among the more showy varieties of Cattleya, Laelia, Brassavola and Odontoglossum. Owing to climatic conditions, work with representatives of the last mentioned genus is confined to the European countries.

The laelia-cattleya hybrids, that is those in which a representative of the genus Laelia is crossed with one from the genus Cattleya—the so-called bigeneric hybrids—are well represented in all collections. Their characters, in most cases, are intermediate between those of the parents, especially as regards the pseudo-bulbs and leaves. Occasionally when a monoplyllous species of Cattleya or Laelia is crossed with a diphyllous form, some of the stems, or pseudo-bulbs of the offspring have but one leaf, whereas others have two, no definite law apparently being followed.

In cypripedium hybrids the parents can readily be recognized by the leaf and floral characters, especially where *Cypripedium Spicerianum* or *C. farrieanum* have been used in the crosses. The production of hybrids between species of Brassavola and Cattleya is receiving more attention at the present time, and those which have been realized represent a distinct improvement over the the laelia-cattleyas. A good specimen of "Brasso-Cattleya Maronae" in the Garden collection was in flower last May. In this bigeneric hybrid, produced by crossing *Brassavola Digbyana* with *Cattleya gigas,* the shape of the flower, manner of growth, the large fimbriated lip and dark green succulent leaves plainly suggest the Brassavola parentage, whereas the light mauve color of the flowers and the elongated leaves and pseudo-bulbs indicate, rather, the Cattleya stock.

Seedlings. The seeds of orchids are exceedingly minute, so minute in fact that a microscope is usually required for their examination. Darwin estimated that a representative seed pod of an orchid contained 1,000,000 seeds. Although these minute bodies are not provided with winged appendages or feathery hairs as are the seeds of the maple and dandelion, they nevertheless are disseminated by the wind because of their extremely small size and weight. Even in a

SEVEN ORCHID SEEDLINGS GROWING ON TRUNK OF TREE FERN.

29, 1912. The seeds resulting from the cross were sown on May 15, 1913, and a month later the first signs of germination were noticed. From the minute green globules first observed a root hair developed and later true roots and a rudimentary leaf. Plate 28 shows some of these seedlings, natural size, growing on an old stem of a tree fern around the roots of *Oncidium ampliatum.* In about four years these seedlings may be expected to produce flowers.

Garden Collection. While the collection of orchids in the Garden is, botanically speaking, one of the most complete in the country, it does not follow that large numbers of them can at all times be seen in flower. The various genera and species have their respective flowering periods and while there are times when many may be seen blooming, frequently the number of flowers is small. It is interesting to note that the flowering period in any one species comes at about the same time in successive years, sometimes varying a few weeks one way or the other. The labiata type of Cattleya with its varieties may be seen practically throughout the year, each variety having its own flowering time.

At the present time the Garden collection includes about eight hundred species and varieties, many of which are rare and unusual. All of the florists' orchids, such as the cattleyas, etc., are represented in the collection but not in large numbers. While the number of blooming species and varieties occasionally drops down to a dozen a month, it rises in December and January to a very much greater number. During these months the cattleyas, laelias, cypripediums, and phaius, varying in color from yellow to bright mauve, are especially abundant and furnish the best display during the year. Other interesting forms which either are in flower or shortly will be, are the elephant moth orchid *(Dendrobium Phalaenopsis* var. *schroederianum)* with twenty spikes bearing upwards of two hundred flowers,several representative specimens of *Laelia anceps,* the two-edged laelia, which will be in flower during January, and the long-spurred wax orchid *(Angraecum sesquipedale)* with two large wax-like flowers. The summer-flowering variety of the latter was figured and described in the July BULLETIN. Further, the nun orchid *(Phaius grandifolius),* one of the earliest terrestrial orchids introduced from China, will have twelve large spikes, each bearing half a dozen large flowers, and the baby's bonnet orchid *(Oncidium lurridum)* with its long pendant spikes, the

of yellow flowers and *Spathoglottis aureo-Vieillardii* the yellow terrestrial orchid, together with various other forms of botanical interest may now be seen in flower.

The following enumeration will serve to give some idea as to the number of species in bloom each month throughout the year 1913: January, 64; February, 17; March, 14; April, 20; May, 13; June, 20; July, 21; August, 22; September, 11; October, 12; November, 24; December, 40; a total for the year of 278.

NOTES.

Dr. Walter Swingle, of the United States Department of Agriculture, visited the Garden on November 29.

The exhibit of primroses and poinsettias is being continued in the floral display houses of the new conservatory.

The Graduate Club of Washington University held its Christmas meeting in the Garden, on December 20.

Dr. George T. Moore, Director of the Garden, addressed the Garden Club of Webster Groves on "The Organization and Work of the Garden Club."

Professor Wm. Trelease, former director of the Garden, and now professor of botany at the University of Illinois, spent November 28 and 29 at the Garden.

On December 3, Dr. Geo. T. Moore spoke before the Alumni Association of the St. Louis College of Pharmacy on "The Missouri Botanical Garden and Its Relation to the Public."

Dr. J. M. Greenman, Curator of the Garden Herbarium, delivered an address before the St. Louis Academy of Science on December 1. The subject of Dr. Greenman's address was "The Flora of the Gulf Coastal Plane."

The Annual Gardeners' Banquet, provided for in Mr. Shaw's will, was held at the University Club on the evening of December 17. Mr. John Noyes, of Boston, gave an illustrated talk on the parks and park system of Boston.

Professor D. T. MacDougal, Director of the Carnegie Desert Research Laboratory at Tucson, Arizona, visited the Garden November 24 and 25. While there Professor MacDougal

STATISTICAL INFORMATION FOR NOVEMBER, 1913.

Garden Attendance:	
Total number of visitors	56,326
Plant Accessions:	
Total number of plants donated	32
Total number of plants received in exchange	84
Plant Distribution:	
Total number of plants distributed in exchange	19
Library Accessions:	
Total number of books and pamphlets bought	29
Total number of books and pamphlets donated	61
Herbarium Accessions:	
By Purchase—	
John Kellogg, Executor of G. W. Letterman Estate—Letterman Herbarium, estimated at	15,000
Michael Gandoger—European plants	1,168
A. A. Heller—Plants of Western United States	450
By Gift—	
George D. Fuller—*Vaccinium ovatum* Pursh from British Columbia	1
More and Milton Greenman—Wood destroying *Poria* from Missouri	1
J. M. Greenman—Private Herbarium—Plants from the New England, Middle Atlantic and Central States, estimated at	10,000
D. T. MacDougal—*Juglans elaeopyren* Dode from Arizona	1
Bernard Mackensen—Plants of Texas	25
Hermann von Schrenk—Plants of Arkansas, Canada, Florida, Michigan, Missouri, New York, Oregon, Tennessee and Texas	68
H. E. Zimmer—*Pholiota heterochita* Fr. from Indiana	1
By Exchange—	
U. S. Department of Agriculture, Bureau of Plant Industry-Cultivated Plants	518
By Field Work—	
Ernest J. Palmer—Plants of Missouri and Arkansas	724
Total	27,958

The Garden is open to the public week days the year 'round from

STAFF
OF THE MISSOURI BOTANICAL GARDEN

Director,
GEORGE T. MOORE.

Assistant to the Director,
JACOB R. SCHRAMM.

BENJAMIN MINGE DUGGAR,
Plant Physiologist.

EDWARD A. BURT,
Mycologist and Librarian.

HERMANN VON SCHRENK,
Plant Pathologist. *Honorary*

CHARLES H. THOMPSON,
Assistant Botanist.

JESSE M. GREENMAN,
Curator of the Herbarium.

MELVIN C. MERRILL,
Research Assistant.

JAMES GURNEY,
Head Gardener, *Emeritus.*

WILLIAM W. OHLWEILER,
General Manager.

CARL GARRETT,
In Charge of N. A. Tract and Rose Garden.

GEORGE PRING,
In Charge of Orchids and Exotics.

HENRY MEIER,
In Charge of Main Garden.

MAX SCHILLER,
In Charge of New Plant Range.